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JOURNAL
OF THE
BOARD OF AGRICULTURE
OF
BRITISH GUIANA.

VOL. XX. JANUARY, 1927. No. 1.

EDITORIAL NOTES.

An apology is due to our readers for the late appearance of this number. The delay has been due to unavoidable circumstances. In spite of this set back, we shall endeavour to bring out our April number on time.

An idea seems to have originated in the minds of some persons locally that this journal should have its pages filled with technical articles and the results of scientific experiments. While we have allowed a certain amount of space to be devoted to such articles for the purposes of record, it has never been the aim or policy of the journal to cater solely for these. In order to state clearly what our policy is, we cannot do better than quote from the Introduction to the first volume.

"First of all then our idea will be to benefit the numerous class of small farmers of this Colony by providing plainly worded information and practical advice on various agriculture matters, taking into account local conditions. By means of this paper we shall endeavour not only to show them how to improve their present methods of agriculture but also to inform them of other products worthy of cultivation and how to set about growing them.

"Secondly, it is hoped to interest the sugar planters and owners and managers of other large estates, by bringing to their notice by means of this journal, improvements that have been effected in the production of their special products on a large scale in other countries, and also by keeping them

informed of the results of the experiments that are being carried out under the Department of Science and Agriculture with sugar-canes, rubber, rice, cacao, etc."

"The various fungoid diseases and insect pests, to the attacks of which all crops are liable at some time or other, will be dealt with in our journal, and, as far as possible, means suggested for their prevention or destruction."

"Thirdly, an endeavour will be made to attract attention and to supply information with regard to the as yet almost unexplored and undeveloped resources of our forests, which occupy an area many times in excess of the lands under cultivation."

We have to admit that there has been some reluctance in the past on the part of local agriculturists and others to contribute articles giving their views and the results of their experiences in the various branches of agriculture in British Guiana. In consequence we have been forced to supplement local contributions by articles culled from other journals when we have satisfied ourselves as to their applicability to this Colony.

We appeal to farmers and others interested in agriculture to assist us with contributions which may be recorded for the use of present and future generations. However, we are assured by the ever increasing number of subscribers and the manifest interest taken in the journal by farmers throughout the Colony, that it supplies a real want in our agricultural community.

An effort is made in this issue to revive and stimulate an interest in agriculture amongst the younger generation. The article on "Boys' and Girls' Clubs," a movement to which we referred in our last volume, indicates where the practice of agriculture should commence. Also the article on "Co-operation" should lead our farmers to realise the necessity for working on this principle if the tilling of the soil, the drainage of the land and the marketing of their crops are to be placed on a sound basis. As was pointed out in our last number, there is room for vast improvement in this direction, and we trust that our farmers will take this lesson to heart, and that it will bear fruit in the near future.

RICE.

By Edgar Beckett, F.L.S.

Rice is a grass—botanically it is known as *Oryza sativa*. It is an annual. Rice has been cultivated for so many years that now the number of varieties is immense. These thousands of varieties differ not only in yield, length of time required for ripening, habit of growth, colour, size and shape of grain, but also in their food value.

The Board of Agriculture has for many years realised the importance of keeping a good grain in this colony, and has for a number of years, carried out experiments both with lowland and upland varieties. The seed padi obtained is distributed to various rice growers every year, and it is interesting to note that, where this seed padi has been distributed the results have been satisfactory.

The necessity for having purity in the strains grown throughout the Colony is very marked. In some districts the writer has observed a red and black grain with "bearded" rice, very predominant. The result has been that, in some districts, the quality of the rice grown is a disgrace to the Colony—broken, red and dark-coloured grain, which is hardly fit for chicken food. If we are to build up an export trade, we must grow padi that will give us a product which compares favourably with the best rice in the world. When it is borne in mind, that our coastal lands are flat clays intersected by deep creeks—with a heavy, impervious sub-soil, it will be seen that in British Guiana, we have ideal lands for growing lowland rices of the very best variety. If drainage and irrigation are assured, we can produce rice which should be second to none, and our yields should be, instead of a paltry 20 bags of padi to the acre, 40 or even more. With respect to these undesirable strains the cultivation of which, it is regrettable to have to state, seems to be on the increase, not only is a most inferior rice the result, but the grains are very weakly attached

to the stalk, with the result that some 15 per cent. of the grain appears to be left in the field when reaping operations are in progress.

Many years ago hybridization trials were carried out at the Botanic Gardens. The flowers were emasculated and pollinated and good grains were obtained.

The rice flower opens early in the morning and usually closes as the day gets warm. Authorities on this subject state that "opening of the plumes and the bursting of the anthers take place more or less simultaneously. According to Van Breda de Haan, an average of three minutes elapses from the opening of the plumes till the bursting of the anthers."—*(The Philippine Agriculturist, August, 1925).*

The work of hybridization, it can readily be seen is one for an experimental station. Experimental work of this nature, as well as careful seed selection, at the various Agricultural stations, where Rice is the prevailing crop of the District, should lead to quicker results, than if these experiments are conducted only at the Botanic Gardens.

Interesting and valuable results clearly demonstrable to the growers in the district would awaken amongst them a more intelligent interest in seed selection.

It is of the utmost importance that the bad strains of padi found in the Colony, should be eradicated, and the Agricultural Instructors in the various rice-growing districts are working with this end in view. With inferior varieties gaining ground every year, there is a grave danger of our Rice Industry suffering severely. Rice was cultivated when the French were in possession of this Colony, and it is well-known that runaway slaves cultivated this cereal for food-purposes, in the first year of the 19th and the last year of the 18th century.

Indeed, in 1810, so large a quantity of rice was cultivated by these runaways, on the back lands of Mahaicony, that a special expedition was fitted out to destroy the cultivation.

The 'Sugar-King' William Russel, in 1843, found rice cultivated in Berbice by the Africans, and it is on record that later a company was floated for the cultivation

of rice up the Demerara river. Gradually interest was awakened and the industry began to grow, though not very vigorous it gave signs of promise in the early eighties. Chinese at Anna Regina successfully grew crops of rice, but the industry was not of much importance, though occasionally when there was a shortage of crops in India, renewed activity led to greatly increased areas being planted.

The real development of the industry is, however, due entirely to the indomitable pluck and energy of the East Indian immigrants—in the face of all obstacles they plodded on, until the acreage had risen from 6,500 acres in 1898, to 61,000 acres in 1918-1919.

Just before the War the acreage was roughly 35,000 acres, in 1924 it fell to 29,400 acres, whilst the total area reaped in 1925 was 39,800 acres.

The yields appear to have fallen, as the average yield given in the Report of The Department of Science and Agriculture for 1925, is 15.4 bags of padi. To quote from this Report : " The actual area occupied by Rice cultivation in the Colony was returned at 29,333 acres, of which 10, 557 acres yielded both spring and autumn crops, the area cropped being 39,890 acres. Of the total area, 9,311 acres were used for rice-growing on Sugar plantations. Due to the favourable weather conditions the crop was a fairly satisfactory one, resulting in 38,103 tons, equal to 614,451 bags, of 140 lbs. of padi and equivalent to 23,042 tons, or to 286,745 bags of 180 lbs. of cleaned rice. The yield per acre reaped was at the rate of 15.4 bags of padi. The rice produced was of good quality and 6,918 tons, were exported during the year 1925. "—*Report, Department of Science and Agriculture for the year 1925, page 9.*

Apart altogether from poor seed-padi, poor cultivation and inadequate water supply or careless saturation instead of irrigation, two factors, in the writer's opinion, have led to the very small yield obtained. These are—first, the fact that in many instances, the grain is sown broadcast, instead of by raising the seed plants in seed beds and planting them out into the padi beds, with two or three, or even less plantlets to each hole. The average yield prior to the War when this mode was more commonly

practised was 20.8 bags to the acre. When everyone was anxious, during the War, to produce food crops for our consumption and the price of padi increased to over $5.00 per bag, the rice growers wishing to grow large areas and not having sufficient labour available to practise transplanting, simply broadcasted seed over carelessly prepared areas. This habit has not altogether been eradicated. The returns for this period show how poor was the yield per acre. The maximum area under padi was reached in 1919, when actually 74,200 acres were reaped, but the return per acre fell to 15.15 bags of padi. In 1920, 65,700 acres were said to be under rice—the yield was only 10.9 bags of padi to the acre. In 1921, 64,100 acres gave 12.4 bags of padi to the acre. In 1922, 60,500 acres yielded only 9 bags of padi to the acre.

In 1923, the Colony's area was 38,700 acres with a return of 13.7 bags whilst in 1924, 40,270 acres yielded 16.7 bags of padi per acre.

The Instructors point out that wherever broadcast sowing is practised the yields are small.

With the supply of labour such as it is, one may expect that, if the price of padi is on the downward grade the areas planted will correspondingly decrease. In 1927, with the price of $2.00 per bag for padi, farmers will be unable to pay off their advances.—They will re-enter the field when padi prices soar again. The result will be a fluctuating area under cultivation from year to year.

In 1926, many farmers were compelled to sow broadcast so as to be able to "catch" the weather—the long delayed rains having prevented any sowing. The area planted and padi obtained will probably show a very large increase for 1926.

With irrigation and drainage, and with plantlets transplanted from seed beds, our yield should never be less than 30 bags of padi per acre.

The other very important factor which is responsible for such poor yields as 15 or less bags of padi per acre is late planting. Unfortunately this pernicious habit of late planting is persistent and prevalent.

It must never be forgotten that, apart entirely from the question of rainfall, the flowers of the rice plant open only in the early hours of the morning and it is only during those hours that fertilization can take place—when atmospheric conditions are suitable. As the sun rises, fertilization is poor and ceases altogether later on during the day.

It follows, therefore, that the best conditions should be sought for to obtain fertilization. These conditions are generally only obtained by planting not later than the end of April—since the end of June and early in July, is the most favourable time for the fertilization of these flowers. With defective or no fertilization, following on late planting, we are bound to get poor yields. Late planting also requires reaping towards the end of November or during December which means that the harvest has to be gathered in during the rainy season.

Another reason for low yields, apart from poor cultivation and little or no irrigation, is that fields cultivated for a number of years may be lacking in available nitrogen.

This, of course, can be remedied by manuring. It must be remembered, however, that our savannah and creek waters with their heavy burden of organic matter or humus, help to keep rice lands in this colony fertile for a number of years.

There is no reason, if cultivators will secure good seed padi and if irrigation is practised along with proper Agricultural methods, why British Guiana should not top the list of the whole world, as regards yield of padi per acre and rice produced. Whether the export trade was spoilt by the restrictions of a late Administrator or not, or whether, as appears more probable to the writer, the market was marred by the extremely poor quality of rice that was shipped, matters little at the present moment.

Whatever should be concerned with is the getting of a profitable yield and the production of a good grain, so that we may be able to become the granary of the West Indies.

With respect to the depth of irrigation water, experience must be the guide. It must not be forgotten that too much water can be as detrimental, perhaps, as too little,

It is obvious that when the rice plants are young and can furnish for themselves little or no shade, the water must be deeper than when growth has made it possible for the water to be protected from the sun. The regulation of the water supply often has an important bearing upon its stooling possibilites. Drainage must be practised, and if the fertility of the land is to be preserved, the rice straw should be ploughed into the land and not burnt. It is said that the hull ashes from the mills contain 0.82 pounds of phosphoric acid and 0.93 pounds of potash—so that it might be wise to give a dressing of these ashes.

Since the drought there has been a small percentage of plants attacked by various insects—farmers should at once acquaint the Government Biologist if they find their plants attacked by any insects at all. So too, if disease is suspected, the Government Mycologist should be made acquainted at once with any suspicious cases.

So far we have been very lucky—but, as time goes on we may find that our rice industry requires protection from insect and fungoid attacks, and it is better to try to at once nip in the bud any threatening danger. In other rice growing countries the disease known as "Blast"—which is associated with, if not caused by the fungus Perricularia, sometimes is responsible for very serious trouble. We can but hope that we shall not have our rice industry wiped out during any year either by some nsect pest such as root lice or fungus diseases.

Growers must learn to co-operate with the Agricultural Department and make heroic efforts to eradicate worthless padi, to sow only the best seeds and to keep a watchful eye on either injurious insects or fungus disease.

Possibly the Government Fruit, Vegetable and Products Depôt, might be able to assist in obtaining good seed padi for sale to *bona fide* rice growers.

It is pleasing to note that there has been some improvement as regards ploughing and threshing.

In some districts tractors and ploughs have taken the place of Biblical plough and oxen and here and there are to be seen imported threshing machines turning out 120 to 150 bags of padi per diem.

The habit of treading out the grain with oxen is still more common than it should be. This practice is one that should not be encouraged.

The question of using artesian well-waters for irrigation has been investigated by the Agricultural Department. When there is a continuous flow of artesian well-water, it has been stated that five crops can be obtained in 2 years. Well-water, however, would not have the same value from the food point of view as creek or bush water. At any rate the question of utilising this source of water supply should not be lost sight of. We should not rest satisfied until we have such an area in good padi, that our Colony should be responsible for 75,000 tons of cleaned rice per annum. This is by no means a fanciful picture, but quite within the realms of practical politics.

ANTHRAX IN THE LONDON ZOO.

During Christmas two valuable elephants, Indiavani and Sundermallah, died at the London Zoo from a disease which was later found to be Anthrax. It appears that the two animals were fed with some imported foodstuffs and that these foodstuffs contained the deadly spores of anthrax, spores which may retain their vitality for years. One animal died some days before his fellow and a post mortem was accordingly carried out, apparantly too late to be of much use for the cause of death does not seem to have been established then. When the second animal died another post mortem was made and this time the presence of anthrax was definitely established by the microscopical examination of blood smears.

Unfortunately four men who assisted in the first post mortem contracted the cutaneous form of anthrax, known as Malignant Pustule, and had the disease in their case not been recognised sooner than in the elephants the results might have been disastrous. They were treated with anti-anthrax serum with satisfactory results. While anthrax in animals is nearly always internal and fata it generally attacts human beings in the skin through some cut or

abrasion and if treated in time the patient's life may be saved. The older treatment was the complete surgical removal of the lesion but the more modern and more successful treatment is with serum or a combination of serum and surgical treatment.

There is also an internal form of anthrax in human beings and this is very fatal ; it is caused by the inhalation of anthrax spores floating in the air in dust and is usually associated with the wool and hair industries—it is commonly called Wool-sorters Disease. Formerly in Yorkshire when the Health acts and the Factory acts were not so stringent as they are to-day it claimed many victims but it is now much less common.

Cutaneous anthrax or malignant pustule is seen in hide-porters, dock labourers, tannery workers, hide, skin and wool workers, butchers and knacker-men. Foreign hides, wools and hair frequently contain anthrax spores and the disease is caused where such spores gain entry through a break in the skin—thus the disease is usually found on the hand, neck or cheek.

When animals die a sudden and mysterious death on no account should their bodies be opened until it has been ascertained that the cause of death is not anthrax. If facilities for examining blood smears are not available and anthrax is in any way suspected two drops of blood should be taken from the ear and smeared on a piece of window glass or on a microscope slide if any is obtainable. This dried blood may be examined at leisure and provided it is fresh, *i.e.*, within three or four hours of death, a certain diagnosis may be made from it. Having taken a smear, burn the carcase, for it is better to have one's curiosity unsatisfied that one's cow pen or pasture infected.

COHEN MC JONES.

A FEW NOTES ON CANINE DISTEMPER.

The recent decision of the Government to put a tax of $5 per head on female dogs in Georgetown and New Amsterdam may do much to reduce the number of

mangy and nondescript curs that one sees in these towns. Their prolificness is rather surprising when one considers that they have everything against them and that theirs is a continual fight for existence. And yet they multiply! How different is the lot of the imported dog, the pure-bred and often pedigree animal which costing a considerable sum in England, has been brought to the Colony by an enthusiastic dog lover. These dogs enjoy a good home and good food, they are groomed and washed, taken out to exercise regularly and except for the change in climate, one would think that they had everything in their favour. And yet they die! How is it that the stray cur, chased from pillar to post, continues not only to survive but to multiply while the carefully tended pure-bred dog not only rarely reproduces itself but often dies! For most cases the answer is distemper!

Distemper here is an absolute curse to the dog enthusiast, for it appears to attack all imported pure-bred dogs and their locally born progeny with extreme virulence and it is doubtful if fifty per cent. of the animals which develop the disease recover from it. Within the past few weeks the writer has seen several valuable dogs succumb, and this, in spite of the fact that everything possible in the way of treatment and nursing was done for them. Some of these animals were Airedale puppies bred here from particularly good parents and two others were a pair of Alsatian Wolfhounds imported from England a few months ago. In the latter case the owner went to particular pains to save his animals but although one lived for five weeks he eventually lost both.

Unfortunately the present state of knowledge regarding distemper is limited to an assumption that it is caused by a "filter-passing virus" and that the best method of treatment is very careful nursing with treatment of symptoms as they arise. In other words we do not yet know the cause of Distemper nor have we any specific cure for it. Roughly explained, a filter-passing virus is one in which no bacteria can be detected by the most powerful microscope and one which may be filtered through the finest of porcelain filters and yet

remain infective. An emulsion of typhoid or anthrax germs passed through such a filter would emerge sterile, leaving the germ behinds in the fiilter, but a similar emulsion of distemper or small-pox emerges much the same as it went in.

Always associated with the primary cause of distemper are a number of accompanying bacteria which are known as secondary organisms and it is very largely due to these secondary organisms that distemper is a disease of so many complications. Although it has not yet been possible to find a vaccine which will completely minimise a dog against distemper, there has been used for some years a mixed vaccine made from these secondary organisms which does much to lessen the severity of an attack. The use of this vaccine, which is generally given in three doses of increasing potency is often just sufficient to help an animal round the corner. However, it is not of much use commencing this treatment when animals are already sick, and vaccination is strongly indicated when animals are bought in England and before they are shipped to the Colony. Alternately to this, one might purchase in England animals which have already had distemper as they then carry a natural immunity which is generally stronger than the one produced by inoculation.

When a dog becomes sickly looking, and lethargic, refuses food and moves about generally, distemper should be suspected. These are the first symptoms and may be followed by watering of the eyes, slight cough, pimples on the abdomen and offensive breath. Often too, worms are passed and this must not lead the owner to think that worms are the initial cause of the trouble. Most dogs have a few worms inside them and like the proverbial rats fleeing from a sinking ship they leave the animal body when it commences to become unhealthy.

In the treatment of distemper nursing is everything, and the animal is to be kept warm and comfortable in an airy place free from draughts.

COHEN MC JONES.

REVISED ARTICLE ON THE CULTIVATION OF BROOM CORN (SORGHUM DHURRA)

By Fitz Greeves.

In planting broom corn, the soil must be well tilled and drained in order to obtain the best results. Very little manure is needed, because when the soil is too rich, the plant produces a very coarse and undesirable straw for broom-making. The seeds may be sown in drills 3 feet apart, and the seedlings transplanted three or four in a hole 3 feet square, or a very small quantity of seeds may be sown permanently at the same distance, and when the seedlings are about 6 or 8 inches high, the weaklier ones must be pulled out and planted in those places where no seeds have grown.

The plants grow very slowly during the first five or six weeks, during which time they must be kept clear of weeds, but after that, with favourable weather, they grow so rapidly that no further care is necessary. They begin to flower in nine or ten weeks, and three crops can be reaped in one year either by replanting or by ratooning. When the ears come clear out of the sheath, and the seeds begin to swell, they become too heavy and cause the straw to bend under their weight—this natural tendency can be obviated by bending the stalk as soon as the panicle comes out of the sheath. Care must be taken not to break the flower-stalk, as then the straw would not ripen,—this process is known as "tabling." Of course it is only the very long ears that would require this operation. When quality and durability are desired, the straw must be cut green before the seeds are fully matured, and stacked in small bundles in a cool place to be cured by the wind; the sun gives it a brown colour which lessens its value. Straw of a greenish hue is sold more readily and at a higher price than the brown one. In the manufacture of brooms, the brown straw detracts from the quality, and in order to command a ready sale for the article, it is coloured artificially.

There are several varieties of this sorghum, but the best yet introduced are the American, Evergreen, Standard, Acme Dwarf and the Dwarf. The last named grows to the height of about 4 feet, and the straw which is used for making whisks is sold at a higher price than the tall growing varieties. The panicle of the Dwarf variety never comes clear out of the sheath, and consequently, the lower part gets stained by insects if allowed to remain for the seeds to mature. A remedy for this would be to cut the straw just as the seeds are changing colour.

USES.

The straw is used for making brooms, the seeds for feeding animals and poultry, and the leaves and stems make a fairly good fodder.

The seeds when cleaned can be ground into flour and used in the same way as any other corn flour.

Brooms can be made at any price to suit the market and the straw can be grown at a good profit to the farmer.

Brooms are now made in the Colony, and there is a ready market for the straw.

CITRUS FRUIT GROWING IN BRITISH GUIANA.

By Fitz Greeves.

The success or failure of a fruit-growing enterprise depends on what the grower starts with.

There was a time, not so many years ago, when some of the best citrus fruits could be obtained in this Colony, but to-day it is difficult to ascertain where a nice orange or grape-fruit can be found. The fault lies not with the trees, but with the growers. The practice now is to knock down, or pull the fruits from the trees before they are full ripe, and place them on the market in a green state. This deplorable method will be continued so long as a market is found for the unripe fruit. The reason given by most growers for this pernicious marketing is that either the birds eat the fruits, or most of the oranges are of a variety that will not turn yellow. There are only a few varieties of the Citrus family that do not change colour when full ripe, and these are of no commercial value.

What is needed to place this Colony on the same basis as other fruit-producing countries such as California, Florida and South Africa, is real propaganda work; to insist on fruit growers caring their trees, manuring them when necessary to improve their condition and the flavour of the fruits—especially oranges—and teaching the correct methods of reaping and marketing such crops.

Citriculture can be made as profitable an undertaking in British Guiana as it is in any other part of the world if carried on in the right way. The soil is suitable, climatic conditions are excellent and a ready market can always be found for a good fruit. It is unfortunate to have to state that this Colony is far behind other fruit producing countries in methods of propagation. The knowledge is there, but there has been no continuity of practice.

To get the best fruits new methods must be employed in growing them. Commercial fruit growing in South Africa for export dates from only 10 or 15 years ago, and

its development has been due, aside from the suitability of climatic factors, to the up-to-date methods employed. The chief citrus fruit grown in South Africa is the orange, and to-day there is a flourishing citrus fruit trade in that Colony. The last three years have seen a tremendous increase in the production of grape-fruit. The use of grape-fruit as a breakfast fruit has increased wonderfully in the last few years in England as well as in Canada and The United States of America.

In most countries where fruits are grown commercially there is a general drawing away from planting seedling trees, for more reasons than one, and consequently budding and grafting have been successfully and extensively carried on to meet the growing demands for such plants. We have been told over and again that budding is impracticable in this Colony. I say emphatically it is not. The art has been practised in Trinidad and other places with 95 per cent. of success for some time now, and from my experience, it can be done here also.

Better understanding of citrus needed. Conditions in the industry on the whole have not been very satisfactory. The plantings which have been set out in the last few years have largely been done by novices. There are few people in the Colony who have any scientific training in citriculture, and this lack of experience and availability of sound advice has made itself too prominent.

Among the problems to be met at present is the securing of plants of the best varieties and the correct method of planting and caring the trees. It is interesting to note that the insect pests and diseases are practically the same as are found in other fruit-producing countries.

DISEASES.

Citrus diseases have been more encouraged than not, from the fact that most people have been in the habit of mulching their trees up to a foot or more from the roots and have consequently formed a congenial habitat for diseases and pests. This practice should be discontinued

if success is to be achieved. Everything should be kept from around the foot of the trees; even the soil should be removed from the collar roots so as to expose them to light. Collar Rot (Mal-di-gomma) is the most serious of all citrus diseases. Wherever the disease is noticeable, the affected part should be cut clear back to green, healthy bark, and covered with Bordeaux paste. In cases where the trees have been partially girdled, a good method is to build rough boxes around the bases and fill them with clay up to the healthy bark in order to encourage the growth of new roots.

RULES TO BE OBSERVED.

1. Do not try to grow oranges on low swampy land; good drainage is highly necessary.

2. Soil saturated with salt is totally unsuitable.

3. Do not plant oranges or grape-fruits between coconuts.

4. Keep your trees clear of bird vine and other parasitic and insect pests.

5. Hard pruning is unnecessary; only dead wood should be removed regularly.

6. All crown or collar roots should be exposed.

7. Manure at regular periods, especially with Sulphate of Ammonia where procurable.

8. Select your buds from best quality trees.

CO-OPERATION.

Co-Operation : Its Principles and Forms.

In the olden days man lived in and worked with nature. He made his own utensils, he formed them in the most suitable ways. He used his thought-power to make them as fit as possible for use, and later on he used his creative power to make them as beautiful as possible. He sang to his work, and the joy in him was transferred from him through his work to his surroundings. He loved work for the sake of the work, and as a result he created good and beautiful things.

Till the beginning of the 19th century, work was done by individuals ; there was no competition ; but every man did his best to create beautiful and useful things. Then the engine was discovered, and as time passed on, the engine was used not for making work easier for the workman, but for one man getting the profit of the work of his fellowmen ; and the economic life of society degenerated into a demoralising routine of monotony. The reason for production was not the demand for goods, but one man's demand for money. No longer do the workers find great joy in their work. Their thoughts are not given to the use and the beauty of the objects they make, but merely to produce the objects. Work which in olden days was the joy of life is reduced to an act of working for wages or profit. That is the level to which humanity has actually fallen.

It is an unhappy circumstance, that people are giving most of their energy and using most of their time each day not to living, not in doing that which would make life worth while, but in earning means which are scarcely sufficient to provide the simple necessities of life. Besides, men are so busy that they have few thoughts left for culture. Well-wishers of humanity are aware of the defects of the

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*A Lecture on " Co-operation · Its Principles and Forms" delivered by Miss Anna Ornsholt, D.T. (Copenhagen), at 4 15 p.m., on Monday, the 22nd February, 1926, at the Clive's Hall, Accountant-General's Office, Fort St. George, Madras, under the auspices of the Madras District Educational Council.

profit-motive in industry ; there is running through society a sense of revolt against certain of its injustices, and a hunger for something better has become so strong that it has gvien rise to many schemes both for reform and for radical changes.

There is one movement which is adapting the ancient and natural principle of service to the present economic system. It is called the Co-operative Movement. It is a movement, where the motive of production and distribution is Service, not profit, and in which it is the aim, that the performance of useful labour shall give access to the best reward. The performance of service must be harmonious and equalised with the consumption of things, that is the ultimate function of the co-operative movement.

The ideal co-operative movement should be that, where the craftsman is helped by the society to perform the best work he can, to make the best things he can. His living should be guaranteed, the things he makes should not be sold in the market for profit. They belong to the society for which he works, and of which he is an equal member. The members who use the products of the society pay the price they cost. Work under these circumstances is true service. The worker gets all the value of the wealth they create, minus what is reserved for the social and the common purpose in which he shares. In this way, service is elevated. It would not be possible for an individual by the ownership of property to have more power and escape the performance of service. The ideal aim of co-operation is to set everybody to work : it is to glorify service instead of property, to eliminate the parasites and the exploited proletariat, and by so doing to establish not the dictatorship of the proletariat but the dictatorship of humanity. An important factor comes in as soon as we begin working with co-operation, and that is education, because only those who know can serve. We must prepare ourselves, we must learn, we must be efficient, if we want to help humanity to greater happiness. If we have co-operation on our programme we must have education also. It is never too late to learn, in fact the whole of life is a school. If we are old, let us start at once with ourselves,

but at the same time let us not forget the children, let us use all our power and our means to give the children education. And how can we serve the world better than by serving the children, who are the future of the world? In the same way as we serve them, in the same way do we serve the future.

Co-operation rests on the principle that we human beings need one another. We need not only to be helped by others, but we need to help others in order that we ourselves may rise to the highest fulfilment of life.

Let us see what the co-operative method does:

1. It substitutes service motive for the profit motive.

2. It makes impossible the large privileged incomes from rents, interests and dividends.

3. It makes everyone a worker.

4. It makes everyone an owner.

5. It encourage thriftiness and the sense of responsibility that goes with ownership and that makes character.

6. It sets the people as neighbours working together for their own interests.

7. It substitutes mutual aid for rivalry and antagonism.

8. It trains the people to administer their own industries in their own interests.

9. It wins back for the worker the long-lost control of his food-supply and of his other natural needs.

Each creative mind takes from the past and gives to the future; each generation stands upon the shoulders of the preceding generation, and we as the present are building the future.

An ascetic once said: "I will go away from the wicked world and live alone." Another man said: "I would be good and happy, were it not for my neighbours." But just as long as our fellowmen are unhappy there is work for us to do; it is through them, we may find the higher life. They need us, and we need them. So long as our

neighbours have need, our place is with them and not out in the forest. Man belongs where mankind is with its problems and its hungers.

It is not true, that man is hostile to man. The dominant natural tendency is to be kind, sympathetic and helpful. Were it not so, the human race would have perished long ago. It is impossible to follow the light of high ideals without contact with others, who have needs. The great inspirations come from our catching the glimpses of the needs of others.

The co-operative movement stands in contrast to antagonistic spirit. It rests upon the natural and loftiest of human impulses. It is creative and not destructive. It has within it the power to enlarge the sphere of the necessities until its operations shall embrace all that is useful and beautiful. This it proceeds to do, not by restricted and competitive methods of business, but through a movement so wide and democratic, that it invites all the people of the world to join it—irrespective of occupation, race, religion or social standing—and to enjoy equal rights in its administration. No new qualifications are necessary. Everybody as he stands to-day as a consumer is eligible. This movement does not demand an exploited class. It desires that all shall come in. The more who join, the greater is the success. This is the test of its humanity. It creates no privileged class, it is all-embracing. It deals with food, clothing, housing and all the material things that the human beings want. And the most important thing with which co-operation deals is the human being itself. To supply this human being with the things for which it hungers and to place it in a more harmonious relation with one another are the functions of co-operation.

There is an impulse which expresses a primitive instinct found buried away in the soul of every individual: it is the desire to serve others, it is a natural impulse. It is suppressed, because it is expensive, but it breaks through the crust of economic determinism now and then and insists on expression. If we want to live an honest life, we must give back to society as much as society gives to us. The un-

balancing of this relation one way or other breeds injustice. In co-operative democracy, the individual discovers that the other members in working for themselves are working for him. Everybody was a common interest. All are serving each, each is serving all. This is the motive which must become universal. As mankind adapts this purpose, humanity will enter upon the era of brotherhood. Society is not organised to promote the best life as long as men find reward in acting selfishly as against the rest of society. The time must come when the individual must ask himself the question : Am I producing good things ? Am I teaching well ? Will these shoes give comfort to those who are going to wear them ? The individual must get away from the idea of producing in the interest of self alone, he must translate his interest into the good of his fellowmen in order that his fellowmen may translate their interests into his good. Man needs not only to bring out the best in himself but also so to act to bring out the best in others. The function of a merchant should be to distribute goods of good qualities to the people who need them, he should not induce people to take goods which they do not need.

Through co-operation, we discover that it is possible for the people to change from self-centred aims to aims that are as broad and wide as humanity. It is slowly driving home by demonstration the idea of a new standard of success. People will have better relation to one another, and the hardness of human contacts will be ameliorated, when men talk more in terms of mutual aid. Co-operation can be lived : it is demonstrating its practical application to-day.

The leaders and most active workers in the co-operative movement in the beginning were working people, socially minded intellectuals, and philanthropists of every persuasion. Many persons of intelligence, who are not satisfied with the state of things as they are and who desire to perform or re-organise the methods of society, have by study and observations been led to look upon the co-operative movement as offering the best hope for the world.

Every country has furnished such workers for the movement from outside the ranks of labour. In some countries these have become the leaders. In Great Britain, Germany, France, Switzerland, Holland, Hungary, Finland and in my own country individuals of the so-called leisure class have been leaders for co-operative movements.

Co-operation cannot progress faster than the people can be trained to understand it and administer its business. It cannot be handed to the people ready made. The cooperators themselves need a large understanding of their movement. Some people say, all that is required of a co-operative undertaking is that it be a financial success, that it saves the people money. This point of view entirely loses sight of the great idea and leaves the minds of the people empty and unsatisfied. Running a cheap store is not a great social aim, it has little social significance. Co-operation truly succeeds only when the people see in it a great social enterprise and are grappled by the desire for justice and the will to make the world a better place to live in.

One of the smallest countries in Europe is my own country - Denmark. It stands out to-day in bold relief because of its prosperity, education and contentment. The force which has chiefly helped to raise Denmark to this position has been co-operation. We say it is the keynote of Denmark. Already 70 years ago, a man named Kristen Kold, inspired by the ideas of his friend Bishop N. F. S. Grundvig started co-education amongst the farmers' children. Several farmers engaged a teacher for their children, and both girls and boys worked together. They did not sit in the schoolroom the whole day, but went out into the fields, the forest, the barn and the stable, and at the same time as they learned the technical side of things, they also saw the practical side of them. This movement expanded and High Schools were built, where the farmers send their young people from their 18-22 year after they had some years of real practical work. It is because of the good and practical education the farmers got, that they took up the co-operative work, and it is from them that the movement expanded. Denmark leads the world in percentage of co-

operators in its population. Amongst the farmers you will find co-operation in all possible ways. They have their own dairies, sugar factories, banks, and stores, where everything can be obtained, from foodstuff to machinery, clothing, etc. There is one way in which co-operation also works amongst the farmers. In the big farms, they usually have their own thrashing-machines, but in the smaller farms where it would be too expensive to have a machine of their own, some farmers) buy a machine, and during the harvest time this machine goes from one farm to another, every farmer sharing his workers with his neighbours.

Alongside co-operation goes co-education. You will scarcely find a school in Denmark where co-education is not introduced: The children start school when they are 7 years old. Most of the schools are public schools, where children from all different homes meet together. After 5 years' training, the children are divided into two sections, those who are leaving school at 14 years and those who are going in for examinations or for University-training. Here is one thing I want to point out to you and that is, that the children are divided after their capacities and not after the fortune of their parents. If the parents cannot afford to support the children during the High School, they are helped by the school with an annual sum of money. The other children who leave school at the age of 14, are in for a lot of practical work before leaving. The girls learn sewing their own clothes, washing, ironing, darning, cooking. The boys learn wood-work, basket-work, bookbinding and gardening. To every big school, a Doctor is attached. Twice a year, the children are examined by him, their measurement is taken, their weight, etc., and if any child has any trace of consumption, it is sent out into the country to an open-air-school, where the consumptive children are kept, and where they live an out-of-door life. A nurse is attached to that school as well as to the big school in the town and also a dentist. Big baths are built in connection with the drill-hall so that the children can get a shower bath after their drill lesson, and once a week, they get a hot bath. As almost all the bigger towns in Denmark are situated near the sea, the children during the summer get swimming

lessons instead of drill. In the winter-time, the children, whose parents go out working, get at least one hot meal a day, and homes are provided, where they can stay from 8 a.m. till 6 p.m. where they are taught handwork in the winter and gardening in summer. And all that is done, because in the management of the school there we again find co-operation. The parents and the teachers meet and discuss the problems of the school. After the war, the profit-method of providing houses for people was paralysed, and private building as well as that of Government and Municipalities ceased. But co-operative societies in many countries continued to acquire land and construct houses and thus solving the housing problem for many of their members.

In Copenhagen, we have lots of these co-operative houses. Some of them are big blocks of dwellings on the principal of a hollow square around a garden court, covering about 80,000 to 90,000 square feet.

The buildings are often 5-6 floors high. These blocks sometimes contain over 200 departments, some with 2-3 rooms, bathroom and kitchen, others with 6 rooms, bathroom and kitchen. Each room looks either to the street or to the court. In all these houses, we find electricity, gas stoves, modern plumbing, central heat, white tiled kitchens and fireproof stairs. In the centre of the big court are beautiful flower-beds, a clock-tower with clock-dials facing four ways. At the four corners are the children's play-grounds with swings, sea-saws and athletic bars, in one corner sand-boxes for the smaller children. There are also some sheltered seats, where the mothers or nurse can watch the children. A cement work encircles the garden and play-grounds, and is used by the children for roller skating, cycling or playing.

It is an interesting fact, that the co-operative houses in Europe are better, cleaner, more homely, less expensive and more beautiful than similar houses owned by municipal government ; it is because of the people who live in them, they are the owners of the buildings and they themselves run them. In some of the co-operative buildings, there

are also co-operative laundries and restaurants. In many towns, the societies have built small houses each one surrounded by a garden. These houses contain 3 rooms, bathroom and kitchen, and have also electricity and running water. During the war and ever since, the co-operative societies have rented land, and every member who wanted, could get a garden. It is impossible to say, how much good these gardens have done the working classes. On all holidays you could see the whole family out in the garden from morning till night. The man built a little shelter of wood, where the wife could make the food for the family. All were busy working in the garden, and it was a joy for them. The wife and children who were otherwise compelled to live in a flat open in a narrow street, now went out on "their land" as they called it. The man who perhaps often in his leisure hours would go to a restaurant now instead went to his garden. Every day after having finished his day's work, he would go out there and stay till 10 o'clock at night. This of course is only possible in the northern countries, where they have sunset late. I have known people who went to their garden at 3 or 4 o'clock in the morning. I am sure we do not sufficiently realise how much good these gardens have done for the future generation. First, they have kept the father of a family away from the restaurant life with its drinking, and smoking, secondly it has made it possible for the wife to provide cheaper and also better food for the family, and brought many of them away from meat-eating, and thirdly it has made the whole family healthier by giving them opportunity to do out-door work. In the banking affairs we also have co-operation, over 100 banks belong to the Danish Co-operative Bank, which has one of the finest buildings in Copenhagen. Why has the co-operative movement come into existence? The world is evolving, and if we want to help in evolution, we can do that through co-operation, because it works for happiness and for the good of the many and only what is good for the many can be good for the one. I have spoken to you about co-operation in so many different ways, but we must bring co-operation into every detail in life, if we want happiness. And there is still one place,

which for me seems the most important, where we must work for co-operation, and that is the home. Perhaps some will say " there we have got co-operation," but I am not certain of it. There is only co-operation in a home, where husband and wife work in harmony, otherwise there is suppression on the one side or the other. What is the good of a man working in the outside world for co-operation, if he is not working in harmony with his own family ? What I mean is, a man must recognise a woman's work in the home, whatever it may be, as equal to his own work. I have often heard men saying : " We are the ones who keep up the homes by our work ; we earn the money from which to educate the children. When man says he is making himself superior to his wife, he puts himself on a higher level and forgets that the woman has given her whole life to her work, she bears the children, she it is who makes the home for the children to live in. It is she that makes the future through the children. And what will the future be, if the woman in the home is not happy, if she is not accepted as equal to the man ? It is the man's duty to introduce the feeling of co-operation and equality in the home. The woman is on the same level as the man, and he must let her feel it.

I have been travelling much in Europe because I wanted to know how people lived in the different countries. I lived amongst the people to learn from them. and I found not in one land, but in them all, that where the husband and wife lived and worked in co-operation, there one found the greatest happiness and the best children. If you read history, you will find that where women were regarded as equal to men, there the country developed in every way to a much higher extent than anywhere else. I think myself very fortunate in having been born in a country where women's equality to men was recognised without fight from the women's side.

To make you realise why we should start co–operation in the home, I will ask you to imagine a picture of a calm lake. Throw a stone into the water, and you will see small ripples arise in circles from the place, where the stone touched the surface, and from there spread out un-

broken to all sides. This will happen if you throw the stone in the middle of the lake, but if you throw it at the one side, the circles will not continue unbroken and we will not get that wonderful harmony as from the first stone. It is the same with co-operation. We must throw the stone in the centre, we must begin co-operation in the centre of all, "the home." We know from history, that it was the family-life which first came into existence, then the village, county-life and national-life. If we do not start co-operation in the home, we shall not get harmony throughout the village, the town, the county, the nation and at last through the whole world. We must begin in the homes, and the waves will spread out to all sides, we will not be able to stop them, they will reach the shore without great difficulty.

Naturally the woman in the house has her own work, which she must fulfil, but the man must recognise her work as equally important to his, he must look upon the work of his wife, his mother, his sister or his daughter as equally important as his own work outside the house. He must realise that the mother is preparing the future of his country through the children. And how can the future be good and happy if the woman does not work under happy conditions: if she is not recognised by her husband as equal to him, if she is a slave. It is the attitude of the man towards the woman which counts. It does not help her, that she is dressed in beautiful clothes and wears costly jewels, if she is treated as an inferior. The woman must feel herself free, she must have the right over her own body, over her own life, she must have the right to know something about life before she is tied by marriage, she must be an equal to the man, only then will the co-operative movement be of real value to the world. We will find, when we study co operation, that education goes alongside. In Denmark, we have for many years had co-operation, co-education and women's equal right to men in daily life, and it is perhaps the country, where you will find the least poverty but also very few rich people. Some men perhaps will say "but we do not want the women to take up our work in the outside world." If they think

like that, then they have quite misunderstood the woman's demand for equality. If the man recognises a woman as his equal, she will with her intuitive power do her very best work for her home, and she will feel the happiness, which will expand to those around her and through them again in bigger and bigger circles to the whole world.

We always compare the man with the head and woman with the heart, and we can be sure that the head will not be able to work well, if the heart is maltreated. We must develop equally the head and heart, then happiness will be the keynote of our work, and the terrible poverty which pervades so many countries will disappear. —*The Madras Bulletin of Co-operation*, Vol. XVIII., No. 4.

WATER EXTRACT OF TOBACCO.

Solution for Spraying Trees.

By Arthur Skibbe, M.A., B.Sc., A.I.C., Assistant Chemist, Elsenburg School of Agriculture, Muldersvlei, Cape Province.

The preparation of tobacco extracts containing an adequate quantity of nicotine for the control of aphis was undertaken by the Elsenburg School of Agriculture for the benefit of the fruit farmer.

For the extraction of the nicotine a number of solvents can be used, but as the object in these experiments was to prepare a suitable home-made tobacco extract, the writer restricted himself to the one most obvious and suitable solvent, namely, water.

In the preparation of a water tobacco extract the following factors would have to be considered:—

(1) Quantity of tobacco used; (2) the amount of nicotine in the tobacco; (3) the condition in which the tobacco is utilized (e.g. stalks or pods or leaves; also whether

ground or not); (4) the amount of water used; (5) the temperature of the water; and (6) the period of extraction.

In the preliminary work the material extracted consisted mainly of the stalks and pods of Turkish tobacco without any leaves but as the extract produced contained a smaller quantity of nicotine than was deemed sufficient, the raw material was discarded and waste Turkish tobacco leaves substituted.

For the satisfactory control of aphis the Division of Entomology recommends a mixture which will contain from 0.05 to 0.1 per cent. of nicotine; in the case of the stalks and pods, however, it was only possible to obtain 0.015 per cent. by using 2 lb. of waste and 3 gallons of water.

With waste Turkish leaves, however, more encouraging results were obtained, and for the preparation of a home-made mixture it would be advisable to use the tobacco waste leaves and water in the ratio of 1 in 10 by weight (viz., 1 lb. tobacco to 1 gallon of water, or 2 lb. tobacco to 2 gallons water, etc.). When these quantities are used, an extract is obtained which will contain between 0.05 and 0.1 per cent. of nicotine.

EXTRACTS BY COLD WATER OR BOILING

For the extraction either cold or boiling water could be used. When boiling water is resorted to, five minutes would prove to be ample; for cold water, an extraction period of 3 to 5 hours would be sufficient. Where the tobacco is added to water which has just been boiled and then removed from the flame, a quarter of an hour period can be advocated.

To reduce to a minimum the loss of nicotine by boiling, it is advisable to use fairly large vessels for preparing the home-made extract. For example, if home-made mixtures were to be prepared in a 4-lb. syrup tin, a paraffin tin, and a 20-gallon drum respectively, with the same supply of heat for the same period of time, the loss of nicotine referred to above in original tobacco leaves in the 4-lb. tin would be great, while the amount lost from the 20-gallon drum would be inappreciable.

For the control of aphis the solutions prepared either with boiling or with cold water proved equally effective.

In a cold solution the rate of solubility is considerably accelerated by the degree of fineness of the material ; with tobacco dust the maximum solubility takes place after the lapse of two hours.

Although the percentage loss of nicotine on boiling a large volume of water with tobacco in the ratio advocated is small, still the same can be reduced to a very small amount by keeping the water at a simmering heat.

When utilizing tobaccos containing a larger quantity of nicotine the amount of water used for the extraction can be increased, e.g. with Virginia tobacco (analysing 1.50 per cent. nicotine) the quantity of water can be doubled (i.e. 1 lb. to 2 gallons of water), while with Nicotiana Rustica (2.2 per cent. nicotine) the amount of water can be trebled (i.e. 1 lb. to 3 gallons of water). In using these ratios the final extract will contain between 0.05 and 0.1 per cent. of nicotine.

A STRONGER SOLUTION.

A more concentrated extract, which can subsequently be diluted, can be made in the following manner: Into a 20-gallon drum containing 18 gallons of water, 50 lb. of Nicatiana Rustica tobacco are introduced as follows: The water in the drum is heated to boiling and then kept at a simmering heat. Small portions of about 5 lb. at a time are then added to the contents of the drum, which are then thoroughly stirred and allowed to simmer for 5 to 10 minutes. The hot waste tobacco is then removed and dropped into another drum containing cold water. The waste is then squeezed to remove excess water and then discarded. The volume of 18 gallons in the heated drum is kept fairly constant by replenishing the same by additions from the second drum, to which periodic additions of cold water are made. By adopting this procedure it is possible to prepare a fairly concentrated extract, which can subsequently be diluted down. By using $52\frac{1}{2}$ lbs. of Nicotiana Rustica tobacco and 21 gallons of water, the writer was able to prepare in the laboratory an extract containing 0.654 per

cent. nicotine. This extract would have to be diluted down ten times with water if it is used as a spray.

The process itself cannot be repeated continuously because the tobacco itself removes about a third more than its weight in moisture. As the solution becomes more concentrated with the later additions of tobacco, the tobacco itself would tend to remove a large amount of the nicotine on withdrawing same from the simmering drum.

These more concentrated solutions, however, do not keep their strength if retained in a drum with a loosefitting lid. Fermentation and other changes take place which largely diminish the amount of nicotine. A sample of extract which originally contained 0.679 per cent. of nicotine, when allowed to stand for three months and then re-analysed, showed only 0.345 per cent. of nicotine. In other words, nearly half of the valuable nicotine was lost. Perhaps it would be probable that the more concentrated extract would tend to retain its strength if placed into a petrol or paraffin tin, which would then be soldered so as not to admit any air.

SUMMARY OF RESULTS.

1. It is possible to prepare a home-made tobacco extract with cold as well as with boiling water.

2. With cold water the rate of solubility depends upon the fineness and quality of the material. With finely ground tobacco dust a period of two hours proves sufficient, while with leaves, 3 to 5 hours would be adequate. When stalks, twigs, leaves, and pods are taken, an overnight soaking will extract the major part of the nicotine.

3. By boiling or simmering, only 5 to 15 minutes are necessary, according to quality of tobacco.

4. Losses of nicotine by boiling are reduced to a minimum by increasing the bulk of solution and heating so as to keep the water simmering.

5. A more concentrated extract can be prepared by adding successive amounts of tobacco to a boiling-water

solution, and the removal of the wet tobacco after being extracted. This process cannot be repeated continuously, as the degree of the extraction obtainable would depend on the nicotine-content of the tobacco.

6. The more concentrated extract (0.65 per cent. nicotine) loses half of its nicotine on standing in a vessel with a loose-fitting lid.

7. Boiling water to which tobacco is added, and then allowed to cool, extracts the nicotine very rapidly.

THE CULTIVATION OF ANNATTO.

By R. A. Hopkins,

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Annatto, Bixâorellana, is a large quick growing shrub, indigenous to tropical America but grown now in many parts of the tropics. It thrives from sea level to an elevation of 3,000 feet and succeeds in almost any class of soil.

Cultivation. Propagation is readily effected from seed, sown either in nursery beds or directly in the field. In the former case a well prepared and slightly raised bed is made under a light shade. To facilitate weeding and easy handling of the plants the beds should not exceed four feet in width. The seed is then sown in drill six inches apart. When the seedlings are above the ground they are thinned out to intervals of four inches in the rows. Growth is rapid and on their attaining a height of six to nine inches they may be planted out in the field at a distance of 10 to 12 feet apart. Light shade, such as is afforded by a small branch taken from a tree should be provided as a protection from the sun until the plant is well established. In many cases the nursery bed is dispensed with and three or four seeds sown at intervals of 10 to 12 feet in the field. All will probably germinate but the strongest seedling only is allowed to remain in

each hole, the remainder being carefully removed in order not to disturb the root development of the selected plant.

Provided the land has been well hoed and cleaned before planting, little further cultivation is necessary, a periodical weeding being sufficient.

Fruiting will commence under ordinary conditions in about eighteen months from time of planting, and will continue for many years.

Harvesting. The fruit consists of two valved capsules of a dark crimson colour, covered with fleshy spines and containing about forty seeds, the latter being surrounded by a scarlet pulp from which the commercial dye is obtained. Harvesting is done when the fruit capsules have assumed a reddish tinge and appear about to burst. It is advisable to cut that portion of the branch bearing fruit, the object being to keep the shrub at a reasonable height and also stimulate future production.

The fruit is spread upon mats or cloths and allowed to dry in the sun for three or four days. During this operation the capsules burst open and disperse the seed. This should then be cleaned by sifting or winnowing and again placed in the sun. Thorough drying will ensure retention of colour and prevention of mould. The seed should then be packed in double bags and marketed as soon as possible.

Yield. The yield is variable. The average production of dry seed per acre in India is stated to be 500-600 lbs. Reports from the Malay Straits state that 5 cwt. per acre was obtained from the first crop, with expectations of an increased yield as the plants became older. There is every reason to believe that crops grown in this territory would show equal if not better returns.

Advices received from Australia assure a regular market for the product at a price not below £30 per ton and ranging under good methods of cultivation to £40, or perhaps as high as £45 per ton.

Uses. Formerly used for dyeing silks, calico, etc. Annatto is now principally employed as a colouring matter for butter, cheese, and margarine.

ECONOMIC ASPECTS OF PEASANT PROPRIE TORSHIP.

Lecture By Mr. P. J. Thomas.

Under the auspices of the Kandy Catholic Club, Mr. P. J. Thomas, Lecturer in Economics at the Ceylon University College, delivered an interesting lecture on "Peasant Proprietorship in its Economic Aspect" recently at S. Anthony's College. The Very Rev. Father D. B. Galassi presided and briefly introduced the lecturer.

Mr. Thomas began his lecture by describing the various systems of peasant proprietorship prevailing in Denmark, Holland, Italy, France, Belgium, Switzerland, the greater part of Germany, and India. He said that in all these countries the peasant proprietor arose and flourished through various favourable circumstances.

In the feudal days of old, most of the land in Europe belonged to the Barons, and the tenants who cultivated the land were merely serfs on the landlord's estate. But gradually under various influences, these serfs became free tenants enjoying some security of tenure, and during the last 100 years, the law had emancipated them and given them full proprietary rights or semi-proprietary rights over their holdings. In Denmark, the peasant proprietary were freed by the legislation of the middle of the last century; and the absorption of peasant properties is now forbidden by law. In France the revolution of 1789 made the peasants real owners of their land which had formerly been burdened by feudal dues; and later much public land was converted into peasant holdings by State activity. Such was the case also in Germany, Switzerland, and Ireland, where to-day peasant holdings are numerous and prosperous. Ireland suffered for long by insecurity of tenure, but by a succession of land laws culminating in that of 1903, tenancies were converted into ownerships, and to-day few countries can boast of a more prosperous peasantry than Ireland, thanks to the unremitting labours of patriots like Sir Horace Plunkett.

MERITS AND DEFECTS.

The most striking feature of peasant proprietorship was the private ownership of land. It was a well-known saying of Arthur Young that "the magic of private property turns sand into gold." Give an industrious man ownership of even a barren plot of land, and he would by hard and unceasing work make it fertile and productive. As John Stuart Mill has emphasised, family affection was here the chief incentive to industry. But ownership was not wholly beneficial in results. It enabled the peasant to get into debt and led finally to alienation of his land. Privately-owned land was again sub-divided between the children of the peasant and thereby excessive fragmentation of holdings took place. Ownership, again, made the peasantry stick to their small plots of land like limpets on rock and this tended to make society unprogressive. On these grounds it was often thought that life tenancies and other forms of occupancy were more economically profitable than complete ownership. An important subject of controversy at present among statesmen and economists was: Should the small holdings newly-opened be on a tenancy basis or an ownership basis? Much might be said on both sides, but, to the lecturer's mind, it depended chiefly on the nature of cultivation. If the tilling was such that permanent improvements did not count and the size of the annual crop depended entirely or chiefly upon the year's labour, it might be said that tenancy would suit quite well. But in intensive culture of all sorts the incentive of ownership or at least long period tenancy was essential for maximising the output from agriculture.

SOCIAL AND MORAL BENEFITS.

The strongest points that might be urged for peasant proprietorship are social and moral. As already mentioned the peasant proprietary were a source of stability to society and formed the best barrier against revolutionary change. Rural folk were essentially conservative and intensely attached to the soil, and they jealously kept up old customs and clung to ancient institutions. They did not change with every current of foreign influence, and were not easily

cajoled into new-fangled ways. The peasantry also supplied the best soldiers and sailors in most countries. As "The Times" (of London) in a recent leading article put it, "From yeomen's sons came the creative energy which has carried England throughout the world and built up her Dominions and Colonies."

The peasant was not merely the material back-bone of society; he fulfilled a valuable moral function as well. The seething masses of the great cities had little moral stamina, but the countryside made up for the city's backslidings. He (the lecturer) had seen peasant life in three leading countries in Europe and his experience was that the rural folk were religious, hospitable, patriotic, level-headed and had a contempt for the shams of life. They were, along with those magnificent cathedrals and beautiful paintings, worthy remnants of the Christendom of old. United Christendom was no more, but rural Europe might by its moral force yet restore the harmony and beauty that once was Christendom. Salvation come from humble Galilee, and not from proud Jerusalem.

COST OF PRODUCTION.

Perhaps the weakest point about peasant proprietorship was on the side of production. Modern agriculture was based on scientific methods, but the peasant had neither the capital nor the knowledge required to utilise the improved ideas and methods used at present. A large farm could profitably employ the latest methods and most up-to-date machinery and thus produce at a lower cost of production per unit. The small farm could not afford to employ such large-scale methods, and hence could not hold its own against its better off competitor. There was much force in this argument. Modern industrial methods were such that only large units could employ up-to-date and efficient methods, and only by using efficient methods could production become profitable. In other words, farming had become somewhat like a manufacturing industry. However, there were various circumstances which minimised the advantages of the large unit in agriculture. In industry the growth of the unit might be accompanied by

increasing returns, but in agriculture the niggardliness of nature inevitably brought diminishing returns instead, although improvements might for a time put off the tendency. The factors that led to increasing returns in manufacturing industries and thus made for the success of large scale operations were (1) an intensive division of labour due to standardization of the processes; (2) the possibility of concentrating production on one spot; (3) the profitable application of complex machinery; and (4) transport facilities. In agriculture these factors had only a limited application. Agricultual operations could not be reduced to routine, the work varying from season to season and therefore standardization was not possible to any considerable extent. Besides, these operations were spread over a large area, and, as Prof. Fay said, a thousand acres of land surface could not be piled up in a centralised factory. Machinery had therefore got only a limited application in agriculture, most of the processes being done by the hand. These were factors which restrict the advantages that a large farm possessed over a small holding. And this had been found true in practice. Some of the expert witnesses that appeared before the Selborne Committee in 1919 even argued that "the gross returns per acre increase in proportion as the size of the farm diminishes." This may not be true of all countries and all types of farming.

WHERE THE LARGE FARM SCORES.

It has to be admitted, at any rate, that in certain kinds of agriculture, in which machinery has been extensively employed, as for example in arable farming, the large farm had the advantage. In ploughing, drilling, reaping threshing and winnowing, machinery is now employed in wheat growing countries, and, as only large farms could purchase them, small holdings were at a disadvantage, especially where labour was scarce and wages high. This could not be said of other forms of farming—*e.g.*, milk production, vegetable growing, fruit farming and poultry keeping wherein machinery played a relatively small part and close personal super-

vision counted for much. In this field, at any rate, the small holding had succeeded and was bound to succeed.

CO-OPERATION TO THE RESCUE.

Personal care could not make up for the lack of capital and enterprise. The peasantry had less command of capital and spent more for manure and seeds than the large farmer and they usually marketed their produce on less favourable terms than the latter. But the principle of co-operation had come to their rescue. Denmark and Ireland among others, had demonstrated to the rest of the world how the small holders could, by combined effort among themselves, secure the advantages of large scale production and wholesale marketing without losing their individuality and private initiative. Co-operative Credit Societies to-day enabled the peasant to get his capital without resorting to the usurious money-lender and he got it on easier terms, and Supply Societies of various kinds brought to the peasant's door his manure and seeds and feeding stuffs at as reasonable prices as a large farmer can purchase them. In cases where machinery was essential, the small holder could now borrow them from his Co-operative Society. Formerly the peasants got lower prices for their produce, but now the Sale Societies enabled them to stand together like a Cartel or Trust, and obtain the highest prices ruling in the market. Improved methods of cultivation and dairying were being demonstrated to the peasantry by the Co-opeative Societies and Government helped them by imparting agricultural education and by opening demonstration farms and experimental stations. It was thus that the Danish peasant made his butter and cheese with the efficiency of a large factory and the Rhenish peasant grew vine as profitable as his capitalist neighbour. The potato growers of Belgium were to-day marketing their produce at top prices and could easily outwit the middleman.

A HARD LOT.

It had also to be admitted that, except in countries where Co-operative Societies had successfully worked the lot of the peasantry was still a hard one. Owing

to the excessive sub-division of property the holdings of the peasantry had become too small. In France and India, at any rate, the sub-division or *morcellement* has gone to such lengths that land had been 'pulverized' or reduced to atoms (*emiettement*). The peasants were proud of their properties; yet, in spite of their hard and incessant toil, they could hardly keep body and soul together. Their parsimony was such that most of them subsisted on the worst diet possible and lived in their kitchens for economy—all this from rounding off their little holdings with some adjoining bit of land coveted by the family for generations. In these circumstances, it was no wonder that rural life became to some extent mean, "miserable, nasty, brutish and short." As Prof. Marshall remarked, "they sacrificed the end for the means." It was said that many of the paid farm-labourers of England earned better incomes, ate better food and led happier lives than the proprietary peasants of France. Such was the opinion of many travellers in France (*e.g.*, Lady Verney), and even economists like Marshall and Lord Ernle inclined to that view. All economists, however, did not agree. "The so-called low style of living" (of French peasants), said Prof. Cannan, "is superior to that of day-labourers in many countries with large and hereditary estates." Such was also the view of Prof. Fay who had studied the subject at close quarters. He said: "While it may be true that many French peasant proprietors are worse off than the average English farm labourer, it is no less true that some are better off; and it is certainly true that in countries like Denmark and Switzerland the large majority are better off." From the point of view of economic efficiency, therefore, peasant proprietorship has many drawbacks which could not be easily rectified. Co-operation had done much to improve the lot of the peasantry, but co-operation was not all-powerful. The excessive sub-division of holdings at any rate, cannot be successfully grappled with by them. Government, with the help of the community, may be able to root out those evils.

Economic efficiency, however, was not the only criterion by which an institution like the peasant proprie-

torship should be judged; there were social and political considerations which could be divorced from the economist's outlook. It might be, they say, that the peasant proprietor lived hard, worked hard, and yet was on the border line of starvation; but the feeling of independence which land ownership gave him and which made him a useful and self-respecting citizen went a great way to compensate for that. Prof. Marshall gave even greater emphasis to this aspect of the question. He said: "They (small holdings) give to the agricultural labourer a stepping stone upwards, prevent him from being compelled to leave agriculture to find some scope for his ambition, and thus check the great evil of the continued flow of the ablest and bravest farm lads to the towns." Nobody would deny in these days that population was one of the essential elements in national strength. If any one doubted it, let him ask a patriotic Frenchman.

ITS LEGITIMATE PLACE.

Proceeding the lecturer said:—

We have now to ask ourselves the question: What was the legitimate place of peasant proprietorship in the present order of things? I shall for the present, make only a few observations. In the older countries which are thickly populated, there is a real need for fostering small holdings; for, in most of them, there is going on an undesirable overcrowding in towns by the migration of young people who possibly are allured by the cheap cinema and other pleasures of town life. The depopulation of the country-side can only be prevented by finding attractions for the people, nearer home. The small holdings will give them honest and honourable occupation and may solve many of their economic problems. In thinly populated countries where land is abundant and labour dear (*e.g.*, Canada, Australion and New Zealand) there is no such pressing need for a peasant proprietary, and in fact these countries have not yet reared such a class. Small holdings thrive best where land is limited and population is growing. Even in such countries the proper position of peasant proprietorship will depend upon the nature of

agriculture. As already pointed out, the farm is likely to be large where cultivation will not be profitable without the application of machinery: where such is not the case the small holding has ample chance. In the case of Great Britain this can be seen well illustrated. When land was used for corn growing small holdings were not wanted; but since vegetable growing, dairy farming and poultry keeping are now becoming profitable, small holdings are increasing, and there is a public desire to have them. It is gratifying to note that even some of the larger land-owners are enthusiastic in this matter.

IN A WELL-ORDERED STATE.

The proposition that corn growing gives the advantage to the large farm has only a limited application in India, because, labour being plentiful and wages low, there is little incentive to the employment of labour-saving machinery. It is not desirable for any country to have exclusively, either large farms or small holdings. In a well-ordered state there must be both kinds of culture. National life will be strengthened by a greater diversity of tenure and types of holding. As Prof. Marshall points out, "there is public need in every district for small holdings as well as large; for allotments and large gardens; and generally for holdings so small that they can be worked by people who have some other occupation." The proportion of large and small holdings in any country should, it seems to me, depend upon (1) the nature of farming, (1) the density of population and (3) the specific social and economic needs of the country. All attempts, by the community or Government, to increase the variety of holdings will certainly increase national welfare. Where small holdings are fostered by Government, it is necessary that it should take special precautions against excessive sub-division of holdings as also against their excessive consolidation. Both are evils to be avoided, if possible, by statutory enactment. Government will have also to decide as to whether ownership or tenancy will suit the needs of the kind of people for whom provision is is being made. Above all Co-operative Societies for credit supply

and sale should be provided and placed on a secure basis, for, it would be futile to open small holdings without such institutions. There is no doubt that on the whole co-operation is the greatest hope of the peasantry in every country and in all circumstances.

MR. STOCKDALE'S REMARKS.

Mr. F. A. Stockdale in proposing a vote of thanks to the lecturer said that they had to thank Mr. Thomas for his interesting lecture. He had depicted the history of agricultural development in England, and had very fairly laid before the house the advantages and disadvantages of peasant proprietorship. He (the speaker) did not intend to dwell on the manner agriculture had developed in the West. In Ceylon, following the lessons taught them by Western methods, the people had acquired wealth by opening rubber and coconut estates. Now Ceylon was thinking of ameliorating the lot of the villager, by starting a system of peasant proprietorship. It was thought that the millenium would be reached once the system of peasant proprietorship came into working order. But only careful and close organisation would bring success.

Mr. Stockdale, continuing, said that in peasant proprietorship, the sub-division of land should not be overlooked. In Ceylon it was difficult to stop the villager from parcelling up the land. Therefore when a system of peasant proprietorship was established there should be legislation to prohibit partition. At present one did not know how to work out the problem. He wished the lecturer had gone into the question to suit the local conditions and contrasted the Western conditions with those prevailing in India. As in India Ceylon was confronted with the problem with no basic data to work on. The speaker said that the conditions of the small man had changed for the worse after war especially in imported articles. In conclusion Mr. Stockdale said that the lecture should stimulate an interest in the subject.—*Ceylon Observer.*

BOYS AND GIRLS' CLUBS.

To Brighten Farm Life and Stimulate the Industry.

By E. J. Shorten, Division of Agricultural Education and Extension.

The question of securing an adequate food supply at reasonable prices and the economic export of any surplus production, is one of first importance in any country. Therefore a sound and efficient system of agriculture is a universal necessity.

One of the foremost means of meeting this necessity is the wise forethought that provides for the adequate education in his rural school of the farmer of to-morrow so that correct principles of agriculture are instilled from youth in the future farmer. An efficient and inexpensive way of securing this end is through the medium of boys' and girls' clubs. Happily, a movement in this direction has recently been started in South Africa.

AIMS OF CLUBS.

The aims of this movement are, briefly—

(1) to foster a love for rural life and make conditions pertaining thereto more attractive;

(2) to educate in accordance with approved modern agricultural methods;

(3.) to combine the interests of teachers, parents, and children;

(4) to develop self-help and teach the dignity of labour;

(5) to enable school children to secure good stock and seed and to teach the proper use thereof;

(6) to develop the social amenities of the countryside;

(7) to demonstrate to the community the lessons learnt in better home and farm practices.

A PIONEER COUNTRY.

The United States of America has made a feature of this branch of agricultural education, and there are hundreds of clubs throughout that country. The movement is subsidized by the Government and by various local bodies. In each county it is under the control of the Agricultural College, and the country agent does the work of organization. Each club has its club leader, secretary, etc. Members of these clubs have to buy all their requirements.

THE MOVEMENT IN SOUTH AFRICA.

In South Africa a begining was made in 1914 in the form of the Boys' Maize-growing Competition under the direction of the Department of Agriculture. This has now grown into a wide and interesting competition, but is almost solely confined to the Transvaal Province. It was formerly administered from the Potchefstroom School of Agriculture, but recently its control was transferred to to headquarters, Pretoria, with a view to extending the field of its operations. The success that has met this competition and the experience of other countries leave no doubt as to the great influence these agricultural clubs have in developing a "farming sense" in children.

In the ordinary course the great majority of our children in rural areas will become farmers or in some other capacity derive their livelihood directly or indirectly from farming. The aim then should be early in life to give them an agricultural bias and to instil a knowledge of the best methods of farming.

GOOD RESULTS OBTAINED.

The Education Department realizes this, and is actively engaged in furthering this object. We can already claim that much has been achieved in this direction in the case of maize-growing. For twelve years the competition, referred to above, has flourished, and wherever the boys have entered, there has followed an increase in production in that area, due to the introduction of better methods and better seed. Yields of twenty bags to the acre are not uncommon, and are often exceeded.

Such a competition, with its 600 entrants, means that there are 600 demonstraton plots distributed over the maize growing areas, resulting in a wide dissemination of the knowledge most required by our maize-farmers, including the use of better seed.

Other branches of farming may similarly be encouraged, such as in poultry, garden crops, pigs, and calves. It is the surest way to increase quality production.

There are three essentials in the success of a club :—

(1) The members have to do all the work themselves.

(2) A clear account of costs and work done must be kept.

(3) Nothing is to be issued as a free gift to a member. Donations in cash or in kind for the purpose of starting a club are to be viewed as a joint liability of the members of the club. The liability must be discharged from the subsequent returns of members, on a percentage basis. Whether the repayment is made to the original donor or is merely placed to the credit of the club, must not effect the principle. The club member must realize at the outset that having been afforded the means of acquiring material gain, it is a first duty, indeed a debt of honour, to make good in a practical manner his indebtedness to the person or other source which provided such orginal means. This will not only inculcate a sense of gratitude, which is so morally essential in our dealings with one another, but will develop the business-sense, which again is so essential to material success.

PROSPERITY LEAGUE CLUBS.

The Transvaal Agricultural Union inaugurated the Prosperity League Clubs some years ago. This praiseworthy scheme has met with a certain measure of success and is supported by the Transvaal Education Department and the Union Department of Agriculture. It is felt,

however, that greater success would follow a closer collaboration between these bodies.

Hitherto no definite aims have been laid down; and no printed literature—so necessary and helpful to those interested in the movement—giving general information and detailing the various projects that may be put into operation, has yet been issued.

PAMPHLETS PREPARED BY THE DEPARTMENT.

The Division of Agricultural Education and Extension of the Department of Agriculture has now, however, prepared a series of pamphlets covering several of these projects, viz.: maize, vegetable growing, pigs, calves, and poultry. These pamphlets are available for distribution to Prosperity League Clubs and to other schools wishing to start such clubs.

It is advisable that each school concentrate on one or two lines only. The members of a club may, however, undertake any project they like, but for the sake of competition it is desireable that a sufficient number should embark on the same projects.

The larger agricultural societies are very keen on encouraging these clubs, and generally make provision for such competitions. As these clubs increase in number and usefulness the societies will undoubtedly evince greater interest and give more opportunites and prizes for competition at their shows.

In the Transvaal any clubs that are formed should be affiliated with the Prosperity League. In order Provinces they should, if possible, affiliate with the nearest farmers' association or agricultural society.

VARIOUS PROJECTS OUTLINED.

The following is a brief outline of some projects:—

Poultry.—Each member to set at least two settings of any approved pure-bred variety, and to feed and house according to modern methods. Local breeders should be approached to donate settings of eggs to the club. This project to start in the late winter or early spring and a

show to be held in the autumn. Costs and full records to be kept of work done. The following season this project can be continued as a "laying test" project.

Dairy Calf.—Donation of suitable heifer calves to be obtained from local breeders and to be drawn for by lot. Each member to feed the calf according to directions. All the work in this and every project to be done by the member. Full details to be kept of feeds used. To be exhibited at the school show.

Gardening.—Each member to grow a certain area of vegetables or flowers. Full details of costs, sales, etc., to be kept and a show arranged at the most suitable time.

Maize.—To be according to the present Boys' Maize Competion. This project differs from the others in that substantial cash prizes, cups, medals, etc., are offered for competition.

Silkworms.—In areas where there are mulberries of the correct variety, this should be a popular project. Silkworm eggs and advice may be had from the Department of Agriculture.

Pigs.—Weaners to be obtained and cared for as for calves.

Any of these projects may be carried on as a "group project" at the school, and it rests with the ingenuity of the teachers and parents to raise the funds necessary to commence these clubs and to collect prizes for the shows.

It may be mentioned here that this year agricultual demonstration plots for public schools were established under the supervision of Miss Alper, of the Division of Agricultural Education and Extension. These plots are situated at the schools, where fertilizing, seeding, and other demonstrations in agricultural practices are conducted. This kind of group or club work is proving to be very popular as it provides a definite project.

TO FORM A CLUB.

The teacher must call a meeting of his staff and pupils and any others interested, such as parents, members

of the local farmers' association, etc. A chairman and secretary-treasurer must be elected, preferably teachers, and from amongst the pupils three committee members. Then it must be decided which projects are to be undertaken and how funds and donations of poultry, stock, etc., are to be obtained. The secretary must thereafter communicate with the Chief, Division of Agricultural Education and Extension, Union Buildings, Pretoria, stating the total number of members, and how many have entered for each project, giving names and ages.

All available pamphlets on the subjects chosen as projects will be provided, also a suggested constitution, which may be amended so as to suit local conditions.

Club meetings should be held at least once a month, and must, of course, be conducted in an orderly manner. To maintain interest it is strongly recommened that at every meeting a short lecture be given by a qualified person, such as an extension officer, local farmer, or the teacher.

Success depends on the enthusiasm of the teachers in the project and their tact in dealing with the parents.

The Department of Agriculture earnestly commends the movement to farmers, teachers, and others interested in the rural areas and the development of our agricultural industry. It is ready to render every assistance in aiding the movement and invites inquiries. These should be addressed to the Division of Agricultural Education and Extension, Union Buildings, Pretoria, and be marked "Prosperity League Clubs."—*Farming in South Africa.*

THE SUGAR INDUSTRY IN SOME OF ITS CHEMICAL ASPECTS*

By Dr. C. A. Browne†

Probably no other food commodity has had so strong a fascination for the economist, the agriculturist, the chemist and the engineer as sugar. In the first place, no other food product has been so frequently subjected to tariff laws, bounties, cartels, and other regulations. In the second place, the operations of producing sugar cane and sugar beets are the best examples of a system of agriculture which, although highly specialised, is probably unrivalled in the extent and complexity of its relations. In the third place, sugar is the only food commodity which is supplied to the consumer in a state of complete chemical purity, the removal of the last traces of contaminating material thus acting as a continuous challenge to the ingenuity of the chemist. Lastly, the numerous operations of sugar manufacture present a greater variety of attractive problems to the engineer than is offered by any other branch of industry. Chemists distinguished in other fields, like Sir William Crookes, have gone out of their way to write treatises upon sugar manufacture, and engineers distinguished in other fields, such as Sir Henry Bessemer, have gone out of their way to invent new machinery for the extraction of sugar. Important epoch-making appliances, like the vacuumpan and multiple effect, now used extensively in all branches of applied chemistry, found their first industrial application in the manufacture of sugar.

Engineers and chemists have too often neglected the agricultural side of sugar production. The costs of planting, cultivating, fertilising, and harvesting make up over two-thirds of the total cost of a pound of sugar, thus leaving less than one-third for the expenses of manufacture. Sight has often been lost of the fact that the cane or beet plant is the real sugar factory, the extraction, evaporating,

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* Read before the Montreal Section on January 18, 1926

† Chief, Bureau of Chemistry, U.S Dept. of Agriculture

and crystallising equipment being simply the means of separating the sugar that nature had already produced. The neglect of the more important agricultural chemical processes in the field, where the sugar is synthesised by the plant from its elementary constituents, is of far greater moment than an attitude of indifference to the chemistry of factory operations.

THE SOIL AND THE CROP.

Chemistry assists the agriculture of sugar production in determining the character of soils and fertilsers, the varieties of crops, and the conditions of cultivating and harvesting which are best suited for obtaining a maximum yield of sugar per acre. Surprisingly little attention has been given to the soil when selecting the sites of some tropical sugar plantations. A newly created plantation in the West Indies with a most expensive modern factory equipment was brought to the verge of ruin through failure to determine in advance the character of the land. The soil proved to be very salty, with the consequence that the sugar cane grown upon it yielded juices of extremely low purity, and so heavily charged with soluble chlorides that profitable sugar manufacture was almost impossible. Extensive drainage has been required to free the fields of this plantation from their excess of salts, and to bring them into a condition suitable for successful sugar production. A preliminary survey of the undeveloped land by an agricultural chemist would have prevented the initiation of such a costly mistake.

The proper treatment of soils where there is a dangerous accumulation of soluble salts is a problem which the growers of sugar crops (both the cane and the beet) must occasionally consider. In the alluvial cane lands of Demerara, Mr. Maurice Bird has found the soil solutiou to contain at times over 1% of soluble mineral matter, consisting of the chlorides, sulphates, and carbonates of sodium, potassium, calcium and magnesium, which tend to accumulate in the surface soil as a result of capillarity and evaporation. This enormous excess, due partly to the concentration of soil water during protracted droughts, may result

in serious damage to the growing crop by causing a diseased condition of the cane known as withering. The dissolved magnesium salts are particularly toxic to the cane unless their influence is counterbalanced by the favouring action of sufficient calcium bicarbonate, for producing which a rich supply of decomposing organic matter is needed in the soil in order to supply the necessary carbon dioxide.

In order to facilitate the removal of salts from defective cane lands it is sometimes advantageous to break up the subsoil to provide better drainage. Periodic flooding of the land is also beneficial. The chemical processes of oxidation, hydration, and nitrification advance with great rapidity in tropical soils, the elements of plant food being made availble in a much shorter period than in temperate zones. This would be a great advantage were it not that the forces which impair fertility are equally rapid. As one result of these chemical changes the soils of the heavy clay sugar lands in Demerara become markedly alkaline during cultivation, a condition made evident to the eye by the solution of humus which colours the drainage waters a dark brown. It is imperative for the maintenance of fertility that the organic matter removed by oxidation and leaching be fully restored.

A peculiarity of Demerara sugar cane juices and sugarproducts, to which Professor Francis, the former Government analyst in British Guiana, called attention forty years ago, is the low optical activity of the reducing sugars. I discussed this interesting question, when I visited Demerara seven years ago, with Sir John Harrison and other scientists. Mr. Maurice Bird attributes the phenomenon to the alkaline condition of Demerara soils, the effect of dilute alkali being to bring the polarizing power of a mixture of reducing sugars to the point of inactivity. Owing to this characteristic of Demerara raw sugars, some refiners, because of the loss of the favourable differential between direct polarisation and sucrose content, which with the raw cane sugar of other countries amounts to several tenths of one per cent., have held that it was less profitable to refine sugars from this colony. The high purity of the Demerara raw sugars, however, nullifies this apparent disadvantage,

which, it should be stated, is not equally pronounced at all seasons.

The value of chemical analyses of soils as a means of determining their toxicity is generally unquestioned, but there is a wide difference of opinion as to the value of such analyses as a means of determining the manurial requirements of a sugar crop. So many factors enter into the question that deductions from soil analyses in one location do not apply to similar analyses in a different environment. It may be said, however, that for a given region of similar agricultural and climatic conditions, soil analyses, when made in conjunction with carefully conducted field experiments over a period of years, make possible the formulation of certain general conclusions as to fertiliser requirements. Thus in Hawaii it has been observed that if the amount of P_2O_5 dissolved from a soil by a 1 per cent. citric acid solution exceeds 0.004 per cent. with an accompanying quantity of 0·15 per cent. soluble lime and silica, no response is obtained when phosphatic fertilisers are applied to sugar cane. In the same way it has been observed that soils with a citric acid soluble potash content above 0·03 per cent. and a fair amount of accompanying soluble lime do not generally give increased yields of sugar cane with applications of potash fertilisers.

THE NEED FOR NEW VARIETIES.

While the production of new varieties of sugar cane and sugar beets is a subject that falls within the realm of plant breeding, the selection of the particular variety of best composition for sugar production devolves largely upon the chemist. The need of constantly improving the existing varieties of our sugar producing crops is always dominant. Certain established varieties may give good returns for hundreds of years, and then show a sudden degeneration from failure to resist new diseases. Thus the old Bourbon variety of sugar cane, which for centuries had been the chief source of the world's sugar supply, began to decline in vigour about forty years ago, and to succumb to the attacks of fungous diseases. The yields of cane fell off enormously, and the sugar industry of the

West Indies would have been ruined, had Harrison and Bovell, in Barbados, not discovered at this time the fertility of sugar cane seed, thus opening the way to the production of new varieties that were resistant to fungus disease. But now another malady of the sugar cane, the mosaic disease, has appeared, and, as the fungus-resisting canes are not immune to this new enemy, there has arisen an urgent demand for harder varieties. Considerable success has already been obtained in producing canes which are resistant to disease and cold. During the past five years the Louisiana Experiment Station has been conducting experiments upon the growing of sugar beets in different parts of the State. The results of the preliminary work indicate that beets planted in November are ready for harvesting the following May, with a yield of about 20 tons of roots to the acre, a sugar content of 12·5 per cent. and a purity of over 84. If a beet crop can be harvested in Louisiana in May—June, and a cane crop in November—December, the economic losses from idle factory equipment will be greatly reduced.

SOURCES OF LOSS.

One of the most serious chemical losses in both the sugar cane and sugar beet industry is the destruction of sucrose in the crop between the time of harvest and manufacture. This loss may result from the inverting action of enzymes after the cane has been cut, or from the fermentation of the crop as a result of injury by freezing, insects, and other causes, or from the natural processes of cellular respiration which take place in all stored plant materials. In the tropics, where sugar cane is sometimes transported long distances, a week or more may elapse between the times of cutting and milling, with the result that under the favourable conditions for bacterial growth the stalks reach the mill in a state of deterioration, the expressed juice being sour and slimy from the presence of acid and gummy decomposition products. The clarification of such juices gives the factory chemist a vast amount of trouble. With very badly fermented cane, sugar making is an impossibility ; working up the juice into industrial alcohol is the only hope of salvaging anything from the wreck.

It has been estimated that the actual destruction of sucrose from cellular respiration during the storage of sugar beets, between digging and slicing, amounts each year in the United States to $5,000,000, and that another $5,000,000 loss occurs in the factory owing to the inability to recover as much sugar because of the accumulation of objectionable nonsugars which have been rendered soluble by metabolic changes in the beets during storage.

The saving of the immense losses which result each year from the deterioration of sugar cane and sugar beets has long engaged the attention of chemists. Immediate dehydration of the sliced stalks and roots has been proposed, the advocates of this scheme holding that among other advantages the dried material can be pressed into bales and preserved for an indefinite period before being worked up for sugar, thus enabling the sugar factories to operate all the year instead of for only a few months as at present. The insufficient margin of profit in dehydrating sugar cane and sugar beets at the present high cost of fuel and low selling price of sugar has been the most serious obstacle to this process of sugar manufacture.

PLANT.

Leaving now the agricultural side of our topic, it remains to discuss raw sugar manufacture in some of its chemical aspects. Manufacturers of sugar have probably been more imposed upon by the purchase of undeveloped and impracticable patented processes and appliances than have those of any other product. It is instructive to visit the sugar factories in Cuba and other tropical countries, and to note the expensive equipment discarded after a brief period of use as uneconomical or useless.

The sugar planter has always shown willingness to adopt any suggested improvement, whether it be a new appliance, such as a filter press or evaporator, or whether it be an entirely new process of manufacture. When the new scheme is backed by capital and well-organised propaganda, the isolated manufacturer is almost helpless if he desires to ascertain the disadvantages of the proposed innovation. Trade publications, whose columns should be thrown open to a free discussion of the pros and cons of

every process, are rarely useful in such an emergency. What is needed is a forum of open public discussion in which both the successful and unsuccessful users of the process can state their experience, for it is only upon the basis of widely disseminated experience that progress can be made. Too often in cases of this kind the purchaser has been sold a problem instead of a well-developed process. Many engineering chemists can no doubt recall in their own fields instances of a hastily exploited device in which the basic principle was sound, but the mechanical or technical development was so imperfect that after it had been tried upon the manufacturing public the original appliance had to be entirely changed.

One thing which always impressed me, during my occasional visits to tropical plantations, was the wonderful durability of the old British sugar-house machinery. I have seen in operation walking beam engines and other appliances that have been in constant use for over 80 years. In commenting once to Sir Francis Watts, the former Imperial Commissioner of Agriculture in the West Indies, upon the excellent lasting quality of this old Scotch and English sugar-house equipment, he remarked jokingly that it was too good, as the purchase of machinery which will never wear out, and which its owner, therefore, will never care to replace, is not always the best economy. Indeed, some hold that the building of appliances to last for more than 20 years is an extravagance, as new, more economical devices which have been perfected should then be installed in their place without further delay. Machinery built for a short existence, however, has the frequent defect of structural weakness, and the heavy over-burden, which sugar making equipment must sometimes bear, demands the most durable kind of construction. This is particularly true in the case of sugar mills, which in grinding the new mosaic-resisting varieties of cane with high fibre content are subjected to enormous strains, far exceeding anything that the designer of these mills imagined.

The tendency of late years has been towards increasing the crushing, shredding, and rolling capacity of sugar cane mills. This is largely due to the desire for better

sugar extraction, but it is also partly the result of an effort to obtain a more closely matted blanket of bagasse far retaining the clarification mud, which in certain processes of manufacture is pressed out between the rollers of the mill. High pressure crushing and milling, however, has brought in its train a number of disadvantages. Much of the bagasse is reduced to a fibrous powder, which finds its way through to the final sugar, and by its moisture retaining capacity exerts an undesirable influence upon the keeping quality of the product. High milling also removes more of the gums and other collodial impurities of the cane, thereby increasing the difficulties of clarification.

Colloidal Impurities.

The U.S. Bureau of Chemistry during the past few years has devoted considerable study to the colloidal impurities of sugar beet juices, the removal of which is the most fundamental process in sugar manufacture. The accurate determination of all the colloidal impurities in juices, syrups, molasses, massecuites, and sugars is a somewhat difficult procedure. The Bureau of Chemistry has employed ultrafiltration by means of standardised collodion membranes as the most suitable means of separating colloids for quantitative determination. These membranes will retain not only all the material which is held by the filters of the sugar factory, but also the minutely divided colloidal particles that pass through. The results of such determinations upon the successive washings of different sugars showed that the colloidal impurities were distributed rather evenly throughout the crystals, which would indicate a continuous absorption of impurities of this type upon the surface of the growing crystals while in the vacuum pan. It is evident that no manner of washing a sugar in the fartory centrifugals will free it from the contaminating colloidal impurities.

The "water soluble" colloidal fraction from one sugar sample examined by the Bureau of Chemistry was found to have a specific rotation of—36°, which is approximately the value for the specific rotation of a gum prepared at the Bureau by Paine and Walton by dialysing beet molasses.

This gummy impurity of the sugar did not reduce Fehling solution until after hydrolysis by hydrochloric acid. This indicates that it is a polysaccharide, probably extracted from the beets in the process of diffusion.

The presence of uneliminated colloidal impurities is not only responsible for various sugar factory difficulties, such as poor filtration, bad vacuum-pan boiling, and delayed crystallisation, but it is also a most common cause of off-colour sugar. These impurities may be of an inorganic as well as of an organic nature. In Demerara much colloidal silica finds its way from the soil into the cane juices and causes trouble in the factory by interfering with the clarification and by producing scale upon the coils of the evaporators. Superheating the juice before clarifying with lime has been found to eliminate much of this colloidal silica, and to cause a marked improvement in the yield and quality of the raw sugar produced.

The liming of juices for clarification has for centuries been one of the most important steps in sugar manufacture, yet until very recently but little effort has been made to place the control of this operation upon a strictly scientific basis. Owing to the well-known destructive action of alkalis upon reducing sugars, with the formation of dark decomposition products, great care is needed in the application of lime to sugar-cane juices. The theoretical quantity of lime for neutralising the free acid in a given quantity of cane juice may be measured, but, because of imperfect facilities and the lack of opportunity for a rapid intermixing of lime and juice, there may occur local zones of liquid that are over-and under-limed. Thus considerable damage may result from the destruction of reducing sugars at one instant by over-liming and from the inversion of sucrose at the next instant by under-liming.

Owing to the fact that the juices expressed from the cane are of constantly varying acidity, it has been impossible to devise a perfectly satisfactory continuous method of liming. The operator who tests the reaction of the juice with phenolphthalein at given intervals may obtain an average ratio of lime for a given flow of uniform juice that is fairly satisfactory, but if the reaction or rate of flow of the juice

should suddenly change he may not detect the difference of conditions in time to prevent damage.

To correct the defects of this syntem of control the Bureau of Chemistry recently conducted experiments in Porto Rico upon continuous electrometer p_H measurements of cane juices by means of an automatic recorder. It was found possible by means of this device to detect rapid fluctuations in the reactions of juices which were not revealed by the intermittent methods of measurement, whether by titration or by p_H determination. With the reading of the automatic recorder constantly before him, the operator was able to adjust the lime control the instant a change in the reaction of the juices was indicated. The results obtained by the use of this new instrument were exceedingly favourble, th extreme fluctuations in reaction, due to temporary or loc el overliming and underliming, disappearing. The existeance of a continuous permanent record of the daily juice reactions is also of value to the factory superintendent for reference. The next obvious step in clarification control will be an extention of the automatic recorder to an automatic device for regulating the addition of lime to the juice. In fact, the accomplishment of this ideal is well on the way to realisation.

The recent war gave an impetus to the manufacture of white sugar on tropical plantations. Some enthusiasts predicted that in a very few years all the cane-sugar refineries of the world would have to go out of business, since they deemed it far more economical to make white sugar right where the cane was grown. This prophecy has never been realised for the reason that no plantation has yet found it possible to manufacture white sugars equal in purity and uniformity of grade to refined sugars. Nothwithstanding, however, the failure of the prediction regarding the expansion of the tropical white sugar industry, there has been a vast improvement since the war in in the quality of the raw sugars produced upon cane plantations.

This improvement in the purity of plantation raw sugars has not, however, always been accompanied by an improvement in keeping quality, which is a characteritics

of the utmost importance when the output of a factory has to be stored over long periods of time. The keeping quality of a sugar is conditioned by two factors—the moisture content and the purity. Sugars of high purity and high moisture content deteriorate very rapidly as a result of the activity of yeasts, moulds, and other micro-organisms. The higher the percentage of soluble impurities in a sugar, the greater the amount of moisture it can retain without danger of deterioration. Various tables and rules have been devised for predicting the keeping quality of a sugar. The best known of these is the so-called "factor-of-safety" rule of the Colonial Sugar Refining Company of Australia, according to which the moisture of a sugar must not exceed one-half the non-sugar if the product is to keep. Experiments conducted over a long period of years at the New York Sugar Trade Laboratory upon raw cane sugars of West Indian origin showed that the moisture should not exceed one-third the non-sugar. This is now the generally accepted figure.

But like all other rules the "factor-of-safety" formula must be intelligently applied. A sugar conforming to the requirements of the formula will not deteriorate only so long as there is no disturbance in the even distribution of its moisture. Let there be, for example, an uneven distribution of temperature in the sugar, and the moisture will be forced to migrate from the warmer to the cooler portion of the mass. There will then be produced zones of sugar with a moisture content above that prescribed by the safety factor, and in these places deterioration will at once begin.

The risk of moisture migration in stored sugar increases with the size of the containing parcels. Smaller packages offer a proportionately larger radiating surface for the same weight of sugar than bigger ones, and hence tend to hold the mass at a more uniform temperature, with less probability of dangerous high moisture regions, being formed. It is for this reason that the storing and shipping of raw sugar in large bulk is a hazardous proposition.

Several instances have been recorded where the deterioration of raw sugars proceeded so rapidly that spontaneous combustion of the product took place with

almost explosive violence. The evolution of so much heat, far exceeding the tolerance of the most resistant micro-organisms, is difficult to explain. The first stages of the process are unquestionably fermentative. During this phase the product may reach a temperature of 70° or 80° which approaches the thermal death-point of the organisms involved. The second stages of the process, when the temperature mounts rapidly upward to the point of ignition, are of a vastly different character. Whether this results from the rapid oxidation of some unsaturated fermentation product, from the sudden decomposition of some unstable endothermic compound produced under anærobic conditions, from the effect of some highly reactive catalytic agent, or from some violent exothermic reaction of an unknown character is a matter upon which at the present time we can only speculate.

Spontaneous decompositions very similar to fermentations may take place in concentrated syrups and molasses under absolutely sterile conditions. For twelve years I have had under observation several samples of molasses that have undergone a slow inversion of sucrose, a gradual destruction of reducing sugars, and a slight evolution of gas, with a constantly increasing darkening of colour. Bacteriological examinations have failed to give positive indications of the presence of yeasts or other organisms. The change seems to be a subdued example of the old hot room froth fermentation, which is not bacterial, and is now attributed by some investigators to a reaction between amino acids and reducing sugars. It is known that under favourable conditions this so-called froth fermentation of molasses may proceed violently, with the evolution of a large volume of gas and enough heat to carbonise the entire contents of the tank.

The Sugar Industry.

The application of strict scientific principles has been followed more energetically in beet sugar manufacture than in cane sugar manufacture. This we would expect, for the beet industry was developed in the highly civilised European countries, where skilled labour was abundant,

and the cane industry was maintained in primitive tropical countries, where labour was shiftless and unskilled. In 1852, taking the whole supply of the world, six times as much cane sugar as beet sugar was manufactured. Beet sugar kept gaining, however, until by 1884 the production of the two kinds of sugar was about equal, a little over 2,500,000 tons each. Beet sugar then took the lead, until in 1899 its production was about 5,500,000 tons, against a cane sugar production of about 3,000,000 tons. Then came the ending of the Cuban war, and with it the application of the scientific principles worked out for the beet industry to the dilapidated cane factories of Cuba and Porto Rico. Modern methods of manufacture had also been busy reorganising the cane industry in Hawaii, Java, Australia, and other countries. The production of beet sugar in 1901 reached nearly 7,000,000 tons, and since then has remained practically stationary. But the increase in cane sugar production, however, has gone forward each year by leaps nd bounds. In 1907 the cane had caught up to the beet, the production of each kind being a little over 7,000,000 tons. In 1908 cane sugar was over 600,000 tons ahead, and in 1909 nearly 2,000,000 tons ahead, out of a total world's production of about 15,000,000 tons.

During the World War the beet sugar industry of France, Belgium, and other European countries suffered a serious setback, large fertile sugar beet areas having been within the zone of conflict and many hundreds of factories destroyed. In order to make up the deficiency thus caused in the world's sugar supply, a great impetus was given to the cane sugar industry of the tropics. At the close of the war the total production of the world's beet sugar had fallen to 3,259,380 tons, while that of cane sugar had advanced to 11,957,232 tons, over 78 per cent. of the entire sugar production. Since 1919 the beet sugar industry of Furope has been rapidly recovering, the total production of the world's beet sugar for the present crop year (1925—1926) being 8,287,000 tons which is 33.9 per cent. of the entire sugar production of the world (24,398,214 tons).

The future development of the world's sugar industry will probably be more extensively confined to sugar-cane

growing countries. This is due principally to the lower cost of producing cane sugar, because of the cheaper labour of tropical countries, and the much greater yield of sugar per acre which the cane gives over the beet. Under the best systems of cultivation and manufacture, such as are found in Hawaii and Java, more than four tons of sugar can be produced per acre. Germany, which leads in the production and yield of beet sugar, can raise barely two tons of sugar per acre. Yet, notwithstanding the natural advantages possessed by the sugar cane, the production of beet sugar is bound to increase for many years to come. The sugar beet, as a root-producing plant of deep-feeding character, plays a most beneficial part in the systems of crop-rotation which are best suited to diversified farming. It is a crop which from the standpoint of both agriculture and national economy should always meet with the most favourable consideration in countries which, like the United States and Canada, are climatically suited to its best development.

CAUSES OF INFERTILITY IN SOILS IN RELATION TO BACTERIAL ACTION.

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Infertility as a negative term suggests the absence of elements required for fertility; it is necessary, however, to realize that infertility may result from the presence of substances or conditions inimical to the growth of plant.

The causes of infertility in soils may, therefore, be divided into two main groups or classes:—

(1) Those associated with the absence of substances or conditions necessary for fertility.

(2) Those depending for their action upon the presence of deleterious substances or conditions liable to interfere with the growth of plants.

To the layman an infertile soil suggests either a desert tract entirely bare of vegetation, or perhaps an area at one time under cultivation but now abandoned because of its infertility. The agriculturist, however, has a much higher standard of fertility in mind ; to him an infertile soil is one which it does not pay to cultivate or at the best is of such poor quality or condition that nothing but necessity would make him spend his time and labour in doing so. To this latter class belongs a large proportion of the arable lands now under cultivation ; these have come down from their original condition of high fertility as virgin soils to their present state of comparative infertility as a direct result of the artificial conditions of plant growth to which they have been subjected during years of crop cultivation. It is with this class of soils requiring highly expert treatment and knowledge that we are mainly concerned, those in which the degree of fertility is so low that relatively small causes, or infertility factors may at any moment reduce their yield below the point at which it ceases to pay to cultivate them. It is therefore of prime importance for the agriculturist to be well acquainted with the various and numerous causes of infertility which may reduce the condition of his soil and the amount of his crop below the paying minimum.

One of the most common and well understood causes of infertility is the lack of a sufficient supply of those ingredients in the soil which are necessary for fertility. It is impracticable here to deal with these except to point out that an insufficiency of plant foods not only affects the growth of crops directly but also indirectly by limiting the activities of those bacteria upon which fertility depends. This is more especially the case with reference to the supply of humus, for reasons to be dealt with later.

Water supply of course is a vital factor and must be taken account of both from the point of view of defi-

ciency and of excess; this implies management of the soil in such a way as to avoid both deficiency or excess of water, the latter with its concomitant result of lack of air being especially conducive to infertility by reason of its effect on bacterial activities in the soil.

On the other hand, infertility may result from the presence of harmful substances in the soil such as excess of organic acids or of alkali salts and in some cases of neutral salts including chlorides, sulphates and nitrates. With these causes of infertility we are not for the moment concerned, but others more generally distributed exist which are of great importance although perhaps not fully recognised as such. Under certain conditions toxic bodies are produced in soils and their influence upon fertility depends largely upon the quantities in which they are present. Generally speaking, their production depends upon the existence of anærobic conditions due to water-logging and is the result of bacterial action of the class associated with this condition. In order to understand not only how such bacterial action takes place but to arrive at an adequate conception of its importance as a factor in soil infertility, it is necessary to know something about that class of soil organisms known as anærobic bacteria. There is no definite dividing line between ærobes and anærobes, that is between such bacteria as require oxygen and those that do not; there is an intermediate class the members of which can tolerate varying degrees of æration or the reverse and even those species which are apparently obligate anærobes can function in presence of small amounts of oxygen, especially in cone junction with certain aerobic species whose activities reduc· the oxygen tension in the soil water. The fact that it is necessary to bear in mind is that soil conditions, so far as anærobism or the reverse is concerned, determine whether anærobic or ærobic bacteria shall predominate in such soils with results which will vary in accordance with the characteristic differences of their action.

Anærobic bacteria and anærobic fermentations are generally associated with unhealthy conditions of one kind or another; thus putrefaction as opposed to decay is pro-

duced mainly by anaerobes, which are also responsible for most septic conditions and incidentally for tetanus.

Anaerobic bacteria in soils produce infertility in several ways:—

(1) By the production of colloidal bodies resulting from decomposition of organic matter, plant residues, roots and stubble, dead leaves, green manures, oilcakes and cattle manure. These colloidal bodies take the form of bacterial waxes or slimes which coat the surfaces of the soil particles and tend to block up the pores of the soil, thus interfering with aeration and drainage. It is of interest to note that the coating of the soil particles both organic and inorganic with bacterial wax has the effect of protecting them from further bacterial action, thus reducing the rate and amount of such important processes as nitrification or organic matter and solubilization of mineral phosphates. The fertilizing action of such partial sterilizing agents as toluene can be partly attributed to their solvent action upon this coating, exposing fresh surfaces to bacterial action; a similar result is produced by the mechanical rubbing and grinding action of cultivation processes such as ploughing and harrowing, and also by the aeration and desiccation resulting from the latter which tends to destroy the colloidal condition of the bacterial slimes. It is important to realize that anaerobism in soils tends to increase by reason of the fact that the anaerobic classes of bacteria, whose growth and preponderance results from the prevalence of this condition, are themselves capable of contributing to and increasing it by the production of colloids; thus the vicious circle is completed and this tendercy becomes of great practical importance.

(2) by the production of toxic bodies which reduce fertility either (*a*) directly as plant poisons, or (*b*) indirectly by their interference with nitrification.

The first case involves exceptional conditions such as waterlogging, or a soil of naturally high non-porosity such as a heavy clay.

Waterlogging in the presence of organic matter results in the production not only of colloids but of plant poisons by anaerobic bacteria. The presence and action of such

poisons can be demonstrated by watering platnts with extracts of anaerobically inculbated soils, apart from the well known effects of attempting to grow plants in soils in which drainage has been interfered with or in which anaerobic fermentation of organic matter has been carried out to excess.

The maize plant affords an interesting case of natural provision against poisoning by organic toxins resulting from soil anaerobism; the secondary aerial root system commonly found in this plant is a provision against the absorption of toxins resulting from anaerobic conditions due to excess of moisture in the subsoil, which the plant is able to avoid by putting out secondary roots into the surface soil at that period of its growth when flooding of the soil is liable to occur.

Intoxication of the seedling maize plant is also liable to occur in wet soils as a consequence of bacterial invasion of the seeds whilst the latter is still attached to and is providing nutriment to the young plant. This form of damage is probably due to mechanical injury to the seed-coat generally as a result of insect attack.

A special case of anaerobism is that produced by the growth of grasses, the closely interwoven roots and stoloniferous stems forming a sod or layer not only relatively impervious but giving rise to extra quantities of CO_2 in the surface soil by their decay. There is reasons, to believe that under certain conditions especially in wet seasons, toxins are formed as a result of the decay of parts of this growth; this result may be noticed where cut grass from the mower is allowed to lie during wet weather on the surface of turf, which is completely killed by this treatment and may not recover for months afterwards. In addition, the partially anaerobic conditions induced in the soil interfere with nitrification and consequently reduce fertility; this effect may be observed and measured and is probably responsible for the very marked and well known inhibitory action of grass upon the growth of trees.

INDIRECT ACTION OF TOXINS ON FERTILITY.

Nitrifying bacteria are known to be highly susceptible to the action of toxins of various kinds. Soil sterilized by

heat is not only lacking in nitrifying organisms but when these are re-introduced by inoculation their normal action is inhibited by toxic bodies produced by the action of heat upon the organic matter present. Similarly anaerobic incubation of soil results in the production of toxins having an inhibitory effect upon nitrification, and in addition cases have been observed where anaerobic conditions in a soil have resulted in the multiplication of specific bacteria, capable of inhibiting nitrification by the toxic action upon the nitrifiers of the bye-products of their metabolism, This action is most pronounced in presence of organic matter. which will fail to nitrify in a soil under reduced air supply, whereas the same soil under similar conditions of aeration will nitrify ammonium sulphate. That this inhibition of nitrification is due to the production of toxins from the organic matter is shown by the fact that nitrification does not immediately take place in a soil treated in this manner when complete aeration is provided subsequently, but only commences after a period of time (some ten to fourteen days) sufficient to allow of destruction by oxidation of the toxins thus formed.

In this case therefore, we have an instance of infertility caused by interference with nitrification and resulting from the action of toxins not present in sufficient amount to produce directly harmful action on plants. The importance of recognizing this source of infertility lies in the frequency of the occurrence of the conditions giving rise to it. Any condition of the soil causing any degree of anaerobism will encourage the growth of those classes of bacteria responsible for the effects described above; such conditions may arise from improper soil management, such as ploughing when too wet, or from physical properties of the soil itself rendering it peculiarly liable to this source of infertility.

RELATION OF THE ABOVE FACTS TO AGRICULTURAL OPERATIONS.

Agricultural operations consist mainly of :—

(1) Cultivation, *i.e.*, stirring the soil.

(2) Irrigation or drainage, *i.e.*, controlling the water supply and with it the air content.

(3) Manuring—the addition of plant food in a suitable form.

(4) Selection of suitable crops and of improved varieties to make the most of natural fertility or to minimize the effects of natural infertility.

Cultivation :—The principal function of cultivation is to regulate the water supply of the soil and promote formation of available, *i.e.*, soluble plant food, especially nitrates. Nitrification depends upon a suitable balance between air and water supply and upon removal or oxidation of certain by-products of bacterial metabolism ; if this is not provided for, either nitrification does not proceed at a sufficient rate or the reverse action, *i.e.*, reduction of nitrates by bacterial action occurs, the bacterial balance being then against the accumulation of nitrates sufficient for fertility. Therefore the operations of ploughing, harrowing, rolling and inter-cultivation must be carried out with a view to maintaining in the soil such conditions of water supply and aeration as will promote nitrification at that time of year when the growing crop is ready to absorb it. Hot weather cultivation has other functions besides that of killing out weeds ; this operation has a very decided action in lowering the percentage of anaerobic, bacteria, destroying many of the deleterious by-products of their growth including some colloids, by oxidation and desiccation, and probably strongly discouraging certain infective and pathogenic organisms such as ***Ps tritici*** and ***Bact solanacearum.*** Ploughing wet has an extremely bad effect on many soils ; the results is infertility due mainly to destruction of the mechanical condition or tilth, this is brought about largely by the operation of a most important factor in soil physics, namely the film of air which coats and closely clings to the soil particles and is only displaced with difficulty ; this air film plays an important part not only in the biological activities of the soil, but in maintaining its physical condition, and exercises a vital influenee in preventing waterlogging of the soil particles. Ploughing the soil when it is dry, by breaking up the particles, increases the area of their surfaces and with it the content

of the air held in the form of the air film upon these surfaces. Ploughing when wet, however, abrades the air film and rubs it off, replacing it with water, removing the permanent air supply and bringing the soil particles into close and adhesive contact. The puddling of clay such as is effected in a pug mill depends upon the action.

Apart from the deleterious influence of compaction upon the biological processes of soil especially nitrification, it must be remembered that plant roots have to penetrate soil by sheer mechanical pressure and that many crops fail to do this in soils or subsoils whose texture is so close as to present mechanical resistance too great for easy penetration; the "pan" liable to occur in arable soils at the lower limit of cultivation is a familiar instance of this condition.

Drainage.—The principal object of drainage is to prevent the formation or persistence of an anaerobic conditions in the soil; it is unnecessary to repeat the reasons for considering anaerobism fatal to fertility, but it may be pointed out that in a soil of average texture and fertility not only may the whole existing supply of nitrates be destroyed in a few days' time by the existence during that period of anaerobism due to waterlogging, but conditions may be set up which will serioulу interfere with the process of nitrification after removal of the excess of water.

Irrigation.—Where irrigation is the standard method of water supply for the crops, knowledge of the infertility factors above described is of even greater importance than in unirrigated areas. Control of the water content of the soil not only places in the hands of the cultivator the power of supplying the water requirements of his crop, but makes it essential that he should possess all the information available as to the relation between soil moisture and the numerous and complicated biological processes making for fertility or the reverse, and dependent on appropriate or mistaken use of this control. As the writer pointed out in a paper in the ***Agricultural Journal of India***, there is great need for research and investigation into the water requirements of soils under irrigation; such enquiries could only be effectively carried out in irrigation areas and must

give due weight to the biological factor. It is probable that the highly important problem of natural fixation of nitrogen in Indian soils is more likely to be solved by study of irrigated than unirrigated soils, and the results of the application the solution will most probably be more readily attained in the former.

Manuring.—The practice of manuring is a recognition of the depletion of soil fertility by the artificial cultivation of crops. It is of course inpossible here to deal with this large subject in any way except to mention one or two points in connection with the relationship between the use of manures and the action of soil bacteria. We may consider as examples the supply of available nitrogen and phosphates as of practical interest and importance.

Nitrogen.—Reference has already been made to the conditions, both favourable and the reverse, whlch occur in soil and which influence the conversion of unavailable organic nitrogenous food into nitrates. It has been pointed out that suitable conditions so far as air and water supply in the soil are concerned must be provided by appropriate cultivation; it it also necessary to know something about the capacity of particular soils to deal with the sources of nitrogen in question, *i.e.*, whether the soil af an area under manurial treatment is capable of nitrifyng the material available for this purpose. This introduces the interesting fact that instances have been found of soils in wnich not only does nitrification not occur, but examination has shown that nitrifying organisms are absent altogether. Although such soils are in most cases of a low grade of fertility and will carry only certain crops, in other instances such as some tea soils, the crop flourishes and responds to ordinary manurial applications in such a way as to suggest that nitrate nitrogen is not necessary to its growth or well-being. This of course is also the case with rice under swamp conditions, to which crop nitrates are apparently not only unnecessary but actually harmful, except in the seedling and in the latest stages of growth. In certain soils from the neighbourhood of Ranchi containing no nitrifiers I have found it possible to induce nitrification by artificial inoculation with nitrifying bacteria, but this

improvement would probably not be a permanent one unless intensive cultivation and applications of lime were maintained over considerable periods.

Another consideration arises in connection with the nitrification of organic manures, this being the suitability of the latter for the process. Observation of the nitrification rate of various nitrogenous materials show a wide variation in their suitability as evidenced by this rate; *mahua* cake for example only nitrifies in soil after prolonged periods of time, probably owing to its content of saponin. In practice, it is important not only to keep this in mind, but to be aware of the fact that nitrification is inhibited both by unsuitable soil conditions and by the application of excessive amounts of organic nitrogenous material. Other important factors come into operation in this connection and must be taken into account, but time forbids reference to them except to mention the possibility of loss of nitrogen as nitrate under conditions where the nitrification rate is so high as to lead to removal of nitrate by leaching by rain water passing through the soil. For this reason it is frequently advisable to apply dressings of cake in separate doses during the growing season of the crop, in place of all at one time.

Phosphates.—The availability of phosphatic manures is intimately connected with bacterial action in the soils to which they are applied. Two distinct styles of bacterial activity are concerned: (1) those which tend to solubilize otherwise insoluble phosphates; (2) those whose action results in diversion of phosphate from the supply originally available for the plant.

(1) It is probable that a large proportion of the naturally available, because soluble, phosphate in the soil is in this condition as a result of acid re-actions set up by bacterial activity, either by formation of organic acids or of carbon dioxide. It was originally considered that this action, generally associated with the decomposition of plant residues, such as green manures, oilcakes and cattle manures, resulted in the direct supply of soluble phosphates to the crop, and might be intensified by the method of composting mineral phosphates with organic matter. Experience,

however, has yielded disappointing results with this method when utilized with the intention of obtaining supplies of soluble phosphates, and it has consequently been largely abandoned; this in my opinion is a mistake, as the apparent failure of the method is due to the appraisement of the results in terms of directly soluble phosphate as is the practice with superphosphate, whereas so far as work at Pusa on this subject has gone it appears that changes in the condition of the original insoluble phosphate due to bacterial fermentation in the compost, take place leaving a certain proportion in a relatively available condition in the form of organic phosphorus compounds, probably constituents of the bacterial cells themselves. Evidence exists leading to the conclusion that the $P_2 O_5$ held in this combination can serve as plant food under soil conditions, either directly owing to the death of the bacterial cells or to later changes in the soil of an indeterminate nature. My present opinion based on field and laboratory experiments is, that bacterial action under suitable conditions is able to convert phosphate into organic combination and remove it from those influences which would otherwise tend to produce chemical reversion to the insoluble tricalcic condition; this organic combination will later present a source of phosphate food of relatively higher availability than the tricalcic form resulting from purely chemical reversion, or existing as such originally. The practical agricultural method of securing this result depends merely upon the provision of adequate soil moisture and sufficient organic matter to promote vigorous bacterial growth and activity; this is one of the principal functions of such operations as green-manuring.

A more specialized style of solubilization of phosphates occurs in the case of that effected by sulphur oxidizing bacteria. Time does not permit of anything more than reference to this process which I described in an article in the "Agricultural Journal of India" (January, 1924) and at the last meeting of the Board of Agriculture at Bangalore. It is of course an artificial method depending on the use of sulphur and bacterial cultures capable of producing sulphuric acid therefrom, but it is of interest to note

that the method is now being tried on a commercial scale as a source of phosphatic manure.

(2) With reference to that class of bacterial action resulting in removal of phosphate from the root range of the growing crop it must always be remembered that bacteria are plants and as such will compete with the agriculturist's crop for plant food in the soil. We have seen that this happens in the case of nitrates and there is reason to believe that it is an equally important phenomenon as applied to the supply of phosphates ; thus superphosphate when applied to a soil is partly taken up by the crop, partly reverted by chemical action, and partly absorbed by bacteria. As we have seen above, there is reason for supposing that this last portion remains relatively available as compared with that which has undergone chemical reversion, so that there is no reason for treating this form of bacterial activity as one likely to produce infertility in the soil.

On the other hand practical experience shows that in our Pusa soils the combination of green manures with superphosphate produces the best results, so thaton the whole we may consider bacterial action in the soil as a favourable influence so far as supplies of available phosphate are concerned, and the aim of the agriculturist should therefore be to encourage such activity as much as possible. This can be done mainly by maintaining adequate supplies of organic matter, and the inclusion of the usual methods of doing so in agricultural practice forms another instance of a correct method based on empiricism derived from experience.

The selection of crops and use of improved varieties is too large a subject to be dealt with here. One point may be referred to and that is the selection of varieties with special reference to the depth of root range of the plant ; here we come in direct contact with soil conditions involving degrees of anaerobism or the reverse, varying in accordance with the character of the soil and its agricultural treatment. Knowledge of the unfavourable effects of anaerobism such as have been described above will not only serve as an additional incentive to the use of such agricultural op-

erations as will tend to diminish this condition, but may lead to the use of shallower rooted varieties in situations where soil and climate may render this additional precaution necessary.

In conclusion, it may be emphasized that so far as soil fertility is concerned, this condition or its opposite can never be ascribed to one simple cause alone but is associated with the interaction of several. It is incorrect to say, for example, that lack of oxygen causes infertility only because plant roots require oxygen for healthy growth; we have seen that conditions in the soil producing an insufficiency of air tend to cause infertility through the combined operation of a number of factors, some positive such as the production of toxins and of colloids by anaerobic bacteria, and others negative such as the failure to form nitrates for want of sufficient oxygen to maintain the proper bacterial balance in the soil. The complete investigation of the reactions and especially the bacterial activities underlying and ultimately responsible for the complex changes and conditions in a soil, is essential and necessary for any understanding of the problem of soil fertility; in this country especially, owing to the high soil temperatures which prevail during a large part of the year, and the correspondingly rapid bacterial changes resulting therefrom, any advance towards solution of this problem must depend upon adequate recognition of the intimate connection between soil fertility and soil bacteriology.—Agricultural Journal of India, Vol. XXI, Part 2.

Meteorological Data 1926.

BOTANIC GARDENS, GEORGETOWN.

1925. MONTHS.	Rainfall.	Number of Days of Rain.						Evaporation
	Inches.	Under .10 in.	.10 to .50 in.	.50 to 1.00 in.	1.00 to 2.00 in.	Above 2.00 in.	Total Days.	Inches.
January	1.93	4	7	...	...	...	11	5.27
February	.85	6	...	1	...	...	7	5.49
March	.56	3	1	...	...	...	4	7.06
April	.48	2	1	...	...	...	3	7.69
May	12.94	...	9	3	4	1	17	4.83
June	20.82	3	8	3	5	3	22	3.65
July	11.60	6	6	3	6	...	21	4.44
August	9.82	8	5	3	4	...	20	5.22
September	2.77	4	8	1	...	...	13	5.37
October	1.48	3	4	...	...	...	7	5.78
November	3.20	4	3	2	1	...	10	4.76
December	13.87	5	9	4	5	1	24	3.58
TOTALS.	80.32	48	61	20	25	5	159	63.14

Stations.	Wettest Day.	Rainfall. Inches	Hottest Day.	Temperature.
Botanic Gardens, Georgetown ...	17th June	4.18	27th July 20th Oct. 14th Nov.	90.0
New Amsterdam Public Gardens...	17th June	4.16	27th July 13th Sept	93.5
Onderneeming Essequibo ...	17th June	3.50	9. 12. 13. Apl. 14. 16. 21. Sept	92.0
Morawhanna N.W.D. ...	3rd July	4.30	...	...

AIR TEMPERATURE AND HUMIDITY IN THE SHADE BOTANIC GARDENS, GEORGETOWN, 1926.

Months.	Air Temperature.			Humidity.
	Maximum.	Minimum.	Mean.	Mean.
January ...	85.4	74.8	80.1	76.7
February ...	85.8	75.3	80.5	74.5
March ...	86.5	76.1	81 3	69.3
April ...	87.7	77.2	82.4	68.9
May ...	86.6	76 9	81.7	76.3
June ...	85.4	76.3	80.8	81.9
July ...	86.1	75.5	80.8	79.3
August ...	86.4	75.7	81.0	79.8
September ...	87.8	76.7	82.2	79.9
October ...	88.1	76.9	82.5	77.0
November ...	88.1	76.5	82.3	77.7
December ...	85.2	75.5	80.3	82.3
Mean ...	86.6	76.1	81.3	77.0

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,209
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	17,461
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...	5,671	1,968	1,642	2,629	1,949	2,539	1,610	18,008
1922 ...	3,557	1,841	1,105	1,593	1,525	1,522	1,397	12,950
1923 ...	4,038	2,780	1,595	1,934	1,953	2,137	1,951	16,388
1924 ...	4,123	2,827	1,103	1,789	1,678	2,146	1,664	15,330
1925	3,317	2,755	1,580	1,819	470	1,663	1,597	13,201
1926 * ..	1,732	2,627	1,219	2,172	364	1,268	1,600	
1st quarter	545	935	410	494	62	175	614	
2nd quarter	363	561	321	432	37	225	379	
3rd quarter	444	538	65	448	85	401	300	
4th quarter	380	593	423	798	280	467	307	

* Decrease in attendances caused by very unfavourable weather conditions.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during 1926.

The corresponding figures for the two previous years and the average for the seventeen years prior to that are added for convenience of comparison.

Product.	*Average 1907-23.*	*1924.*	*1925.*	*1926.*
Sugar, tons ...	98,677	85,896	97,714	84,659
Rum, gallons ...	2,616,395	769,308	1,148,119	789,642
Molasses, gallons ...	113,338	1,160,757	1,345,243	2,017,862
Cattle-food (Molascuit) tons	4,291	1,102	1,268	1,075
Cacao, cwts. ...	346	None	None	None
Citrate of Lime, cwts.	154	None	None	None
Lime Juice, gals. ...	* 10,286	9,785	8,430	1,974
Essential Oil of Limes, gals. ...	* 366	396	306	277
Coconuts, thousands...	1,690	1,560	1,363	816
Coconut Oil, gals. ...	* 22,058	21,804	30,394	18,778
Copra, cwts. ...	1,589	16,508	17,278	34,111
Coffee, cwts. ...	2,837	4,581	5,964	6,904
Kola-nuts, cwts. ...	12	None	None	None
Rice, tons ...	6,566	4,470	6,918	2,914
Ricemeal, tons ...	713	None	None	None
Cattle, head ...	656	391	514	44
Hides, No. ...	5,041	8,902	9,801	7,916
Pigs, No. ...	690	427	889	550
Sheep, head ..	65	37	14	None
Balata, cwts. ...	10,593	12,234	8,079	5,334
Charcoal, bags ...	60,033	42,040	3,265	38,504
Firewood, Wallaba, etc., tons	8,095	6,477	6,143	7,716
Gums, lbs. ...	2,900	708	477	2,034
Lumber, ft. ...	225,535	180,863	146,561	189,034
Railway sleepers, No.	9,144	39,238	39,779	10,793
Rubber, cwts. ...	66	35	96	307
Shingles, thousands	2,394	1,278	1,892	1,312
Timber, cub. ft. ...	120,896	168,454	216,749	313,461

*An average for eight years 1916 to 1923.
No records available prior to 1916.

JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

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MEETING OF THE BOARD OF AGRICULTURE.

A Meeting of the Board of Agriculture was held at the Court of Policy Hall, Public Buildings, on Tuesday, the 26th day of April, 1927 at 2.30 p.m.

The following were present:—The Acting Director of Science and Agriculture, W. Francis, Esq., F.I.C., Acting Chairman. The Honourable R. E. Brassington, Stanley De Freitas, Esq., M.A.,F.R., S. H. Bayley, Esq., E. M. Walcott, Esq., H. L. Humphrys, Esq., F. A. Mackney, Esq., The Superintendent of the British Guiana Sugar Planters' Experiment Station (Dr. C. L. Whittles), The Director of Co-operative Societies (G. L. B. Gall, Esq.,) The Economic Biologist (L. D. Cleare, Esq., F.E.S.) Edgar Beckett, Esq., F.L.S., The President, The British Guiana Farmers' Conference (H. A Britton, Esq.,) J. J. Da Silva, Esq., with E. M. Peterkin, Secretary. The Acting Government Veterinary Surgeon was also present.

Excuses were tendered on behalf of the Hon. C. D. Douglas-Jones, C.M.G., Colonial Secretary ; the Commissioner of Lands and Mines, the Hon. G. D. Bayley, C.B.E.; the Representative of the Royal Agricultural and Commercial Society, G. E. Anderson, Esq., and R. Strang, Esq.

The minutes of the previous meeting held on the 24th day of September, 1926, having been circulated to

the members of the Board, and having received their approval, were on the motion of the Chairman seconded by the Hon. R. E. Brassington taken as read and confirmed.

The Chairman reported:—

The resumption of duty of Mr. H. L. Humphrys.

The assumption of duty of Mr. Wm. Nowell, D.I.C., F.L.S., as Director of Science and Agriculture and Chairman, Board of Agriculture, on the 1st November, 1926, and his promotion on the 16th November, 1926, as Director, Amani Research Institute, Tanganyika Territory.

Application from Mr. T. Earle for two months' leave of absence.

Application from Mr. G. E. Anderson, Representative of the Royal Agriculture and Commercial Society for six months' leave of absence.

Application from Dr. C. L. Whittles, Superintendent, British Guiana Sugar Planters' Experiment Station, for six months' leave of absence.

Death of filly foal at the Stud Farm, D'Urban Park.

B. Troop stable and compound, Eve Leary, quarantined for glanders on 20.11.26,—quarantine lifted on 11.12.26.

Death of imported ram sheep at Onderneeming.

Affiliation of the Berbice Agricultural and Industrial Association.

Affiliation of the Beterverwagting and Triumph Farmers' Association.

Appointment of Mr. Stanley De Freitas, M.A., F.R., as an ordinary member of the Board.

Appointment of the Hon. C. D. Douglas-Jones, C.M.G., Colonial Secretary, as an ordinary member of the Board.

Appointment of Mr. F. A. Mackey as an ordinary member of the Board.

The re-appointment of the Economic Biologist as an ordinary member of the Board.

The re-appointment of Mr. E. M. Walcott as an ordinary member of the Board.

The re-appointment of Mr. R. Strang as an ordinary member of the Board for one year.

The expiry of the contract with the Daily Chronicle for printing the Journal of the Board of Agriculture and its renewal.

The following appointments were made to the Board's Committees:—

EXECUTIVE COMMITTEE.

The Hon. C. D. Douglas-Jones, C.M.G., Colonial Secretary.

AGRICULTURAL EXHIBITIONS COMMITTEE.

Stanley De Freitas, Esq., M.A., F.R.
E. Beckett, Esq., F.L.S.

SUBSIDIARY PRODUCTS COMMITTEE.

F. A. Mackey, Esq.
E. Beckett, Esq., F.L.S

LIVE STOCK COMMITTEE.

Stanley De Freitas, Esq., M.A., F.R.

PLANT DISEASES AND PESTS COMMITTEE.

The Assistant Botanist and Mycologist (Co-optative), The Superintendent of the British Guiana Sugar Planters' Experiment Station.

The Chairman laid on the table :—

Report on Farmers' Competition held on the East Coast of Demerara in December, 1926.

Journal of the Board of Agriculture, Volume XIX, No. 1. Journal of the Board of Agriculture Volume XX, No. 1. Annual Report of Sophia Sugar Experiment Station from 1st October, 1925, to 30th September, 1926.

List of Registered Veterinary Surgeons for 1927.
Agricultural Census Returns for 1926.

Report on Berbice County Agricultural Show, 1927.

Report on Beterverwagting Agricultural Show, 1927.

Services of Stud animals for 1926 and where stationed.

Report by Mr. R. A. Altson, A.R.C.S., B.Sc., Assistant Botanist and Mycologist on the suspected outbreaking of Mosaic disease at Sophia and Mr. Nowell's remarks thereon.

Report on present position of *Antidesma*. After some discussion, Mr. Britton moved seconded by Mr. E. M. Walcott, that the Government be asked to take action at once as this pest was becoming a serious menace to Agriculture. This was carried unanimously.

The Chairman moved that three of the four ram sheep imported in September, 1926, be sold at cost price. Mr. De Freitas asked that if sold they be disposed of at auction, but that he was opposed to selling them, as no useful purpose would be served thereby. If the Department seriously proposed to improve the sheep in the Colony it would be necessary to establish a large flock and have annual sales. After some discussion it was decided that the sheep should not be sold but stationed in the farming districts.

The Chairman submitted the decision of the Agricultural Exhibitions Committee with regard to the allocation of Vote No. 62—Grants-in-aid of Agricultural Shows, Exhibitions and Competitions—$2,000.00 as under :—

Berbice County Show ...	$1,000.00
Beterverwagting District Show ...	200.00
West Bank Show	200.00
Farmers' Competition, W. B. Demerara ..	120.00
Farmers' Competition, Mahaicony ...	60.00
Farmers' Competition, Plaisance	60.00
Affiliation Grants	160.00
Department's Expenses	200.00
Total	$2,000.00

This was, on the motion of the Chairman, seconded by the Hon. R. E. Brassington, confirmed.

The question of individual exhibits obtaining prizes at more than one Show was discussed. It was decided that it was undesirable at present to place any restrictions on this, as the interchange of exhibits from one district to another very often serves as an object lesson of what could be done if they tried.

The Chairman stated that the Secretary, Board of Agriculture, had submitted the following suggestions for the improvement of the quality of rice grown in the Colony, and invited discussion :—

" The Chairman,

" Board of Agriculture.

" Sir,

In view of the steady deterioration of rice in the " Colony, a matter of great urgency and importance, I " have the honour to submit the following suggestions for " your consideration and that of the members of the " Board of Agriculture.

2. Fifteen acres of rice are cultivated at the Botanic " Gardens producing 41,562 lbs. of specially selected seed " padi, which is distributed to farmers of the Colony for " the purpose of improving the quality of rice grown. At " one time a large percentage of the padi was given to " poor farmers free of charge, but as there was no apparent " improvement in quality a nominal price was charged to " impress on their minds the value of this seed. This " method has also proved a failure, only a few growers " having benefited thereby. At present the farmer pur- " chases his seed padi from the Botanic Gardens, plants " and reaps his crops and sells every grain that is produced " without retaining any from this specially selected seed " plot for replanting. He again purchases seed from the " Department and the same procedure is followed year by " year."

3. These experiments cost $2,000 per annum " which is money expended without any permanent benefit " to the Colony."

4. I suggest that the Inspector of Districts be "asked to arrange for the cultivation of small areas, in "the various rice growing districts, to be planted with "selected seed from our next crop, which will serve as "centres of distribution to each district for the following "year. The seed padi can be sold to the farmers at a "price to cover the cost (rent, value of padi, cultivation, "etc.) of these plots, which can be increased in size from "year to year. This scheme should, in a few years enable "practically the whole Colony to be planted with selected "seed padi."

5. This scheme could be initiated without any "actual cost to the Colony. All that is required is an "advance from the Government to start the plots. This "advance will automatically be recouped when the crop is "reaped and sold, and if a reasonable profit be allowed "for, these plots will eventually become self-supporting."

6. It is useless to leave the question of improve- "ment to the farmer. He has proved himself too lazy "and improvident in the past to expect any improvement "from him."

7. These plots should be under the personal super- "vision of the Travelling Agricultural Inspector, assisted "by the Resident Agricultural Instructors. When on "their regular visits to the districts in question they can "inspect them without incurring increased travelling "expense."

I have the honour to be,
Sir,
Your obedient servant,
(Sgd.) E. M. Peterkin,
Secretary, Board of Agriculture.

It was agreed that the quality of rice in the Colony was very poor and that steps to improve it were necessary. The Chairman suggested that a more comprehensive scheme be drawn up.

The report of the Special Stock Farm Committee was not submitted as it was not completed in time.

The Chairman reported that he had received an offer from the Trinidad Department of Agriculture to exchange their Stallion "Nelsweep" with the Government Stallion "Waterbass" for a period of six months. After some discussion it was decided to accept the offer.

The Chairman reported that arrangements had been made to import 1,000 suckers of the Giant Fig Banana. These would be planted at the Board's Quarantine Station, Brickdam.

The chairman moved the following By-laws for the control of the Plant Quarantine Station, Georgetown:—

1. The Station shall be situated in such place as the Plant Diseases and Pests Committee may decide from time to time.

2. Visitors shall not be permitted unless properly authorised

3. Trespassers will be prosecuted.

4. No person shall remove any plant or part thereof from precincts of the Station, without written permission of the Chairman of the Board of Agriculture or his Deputy.

5 Every person who infringes these By-laws is liable, on summary conviction, to a penalty of Twenty-four dollars (Ordinance 14 of 1891-21 (b))

These were seconded by the Government Economic Biologist and carried unanimously

Mr Britton asked the following questions notice of which had been given :—

1. *Question.*—Whether or not there is on record a positive case of Panama Disease in local Banana cultivation ; if there is no known case, will the Department of Science and Agriculture take steps to ascertain whether or not the disease exists in the Colony ?

Answer.—The following Memorandum on Panama Disease prepared by Mr. R. A. Altson :—

MEMORANDUM ON PANAMA DISEASE.

"An exhaustive examination of departmental reports "from 1880 to date shows that Panama disease of bananas "has never been recorded in this Colony.

"The only diseases of musaceous crops (i.e., plantains "and bananas) which have been reported are the "following:—

"(1) A bacterial disease affecting plantains, and at least "one type of banana, namely the Dwarf or Chinese "(*Musa Cavendishii*).

"(2) A disease, said to be caused by a fungus "(*Ustilaginoidella oedipigera*), known as Surinam disease "or 'elephantiasis', which is quite distinct from Panama "disease, and of little economic importance.

"(3) Anthracnose of banana fruits due to *Gloeosporium* "*musarum*.

"The bacterial disease of plaintains or, as it is usually "called 'plaintain disease' has been known in the Colony "for a great number of years, but it was not until 1915 "that its bacterial origin became recognised. I believe it "to be identical with a disease known in Trinidad as "'moko-disease', which has recently been shown to be due "to a bacterium (*B. Solanacearum*) known in many parts "of the world as the cause of destructive wilts in several "crop-plants.

"The external and internal symptoms of plantain "disease are very similar to those of Panama disease, and "this is not surprising, for although their origins are quite "distinct (Panama disease being caused by a fungus, "*Fusarium cubense*), both are diseases of the vascular "system. On account of this similarity, I have no doubt "that cases of this bacterial disease have at times been "mistaken for Panama disease. However, they differ very "widely in their relation to the various types of musaceous "crops. The Gros Michel or Jamaica banana is extremely "susceptible to Panama disease, but resistant to the "bacterial disease. On the other hand, plantains, which "are very susceptible to the bacterial disease are immune

"to Panama disease, and the Dwarf banana although "susceptible to bacterial disease is highly resistant to "Panama disease.

"The well known fact that the ravages of Panama "disease were responsible for the failure of a highly "organised banana industry in Surinam, has led to the "belief that this disease must of necessity be present in "British Guiana.

"There appears to be no evidence, other than that of "a casual field observation, that Panama disease existed in "Surinam prior to the establishment of the banana industry, "that is, prior to large importations of suckers from "Jamaica. These importations were made in 1906. In "the following year, according to a statement made by the "then Surinam Government Botanist, 'some cases of "Panama disease were noticed, but it was not yet serious.' "By 1908 the disease had begun to cause heavy losses "and this was the beginning of the end of the Surinam "industry.

"It is now known (though at the time the knowledge "was wanting) that in 1906 when the importations were "made, Panama disease was present in Jamaica having "been introduced by labourers returning from the infected "fields in Panama, and there is therefore decided justi-"fication for supposing that the disease was introduced into "Surinam on the imported suckers.

"Four official introductions of banana suckers into "this Colony from questionable sources are on record. "Three from Jamaica and one from Surinam.

"The three from Jamaica are not, in my opinion, "open to suspicion. The first two were made at a period "(in 1888 and 1890) when, it is safe to assume, Jamaica "was free from the disease, for it had not then developed "in Panama. The third took place in 1905, when suckers "representing 27 varieties, mostly of Asiatic origin, were "received from the Hope Gardens. These gardens are "known to have been free from infection at that time. "The fourth introduction, that of the Congo banana from

"Surinam in 1914, might at first be regarded with suspicion, "but, considering the circumstances under which it was "made, there can be little doubt that every precaution was "taken to prevent the admission of the disease.

"Of course, it cannot be stated as a positive fact that "Panama disease is absent from British Guiana; but only "that there is no evidence that it is present. Were culti- "vators regularly to submit suspicious cases for examina- "tion it would be possible, after a period of time, to ex- "press a more definite opinion in regard to this matter."

"Suspicious cases would be cases of wilt occurring in "the Gros Michel (Jamaica or Martinique) banana. Cases "of wilt in plantains, Dwarf, Giant Fig (Cokerite), Congo "or red bananas do not fall into this category.

(Sgd.) R. A. Altson.
Assistant Botanist and Mycologist."
12/1/27.

2. *Question.*—What, if any, are the citrus and other fruits, budded from standard varieties, that are now available to the public at the Botanic Gardens; if none, when will such be available?

Answer.—There are none available at present, and none will be available for some time. It will be 18 months before the seedlings now being grown for stock will be fit for budding.

An early start in this direction is hoped to be made. A consignment of bud-wood is shortly expected from Trinidad, and specially named varieties from Florida.

3. *Question.*—Has the Department of Science and Agriculture taken steps through the Executive Government to obtain for the Colony a grant from the £1,000,000 Imperial Vote, to be utilised as a nucleus for founding a Fruit Industry as per Report of the Economic Committee.

This was postponed.

4. *Question.*—How many of the Agricultural Students, who received training at the Botanic Gardens, have by

Government been settled on the land; if none, why?

This was postponed.

5. *Question.*—Whether or not the Acting Director of Science and Agriculture will take steps to introduce a better variety of Citrus Fruits, e.g., Washington Navel Seedless Oranges and Grape Fruit?

Answer.—The following minute written by Mr. E. Beckett, Travelling Inspector:—

"Acting D. S. A.,

"With respect to the Washington Navel "Seedless Oranges—these were imported when Mr. G. S. "Jenman was Government Botanist. They did very bad-"ly, producing fruit that were extremely poor, lacking in "juice and flavour. The late Mr. Junor also reported "adversely against this well-known Orange. Apparently, "climatic or atmospheric conditions were against it.

(Sgd.) Elgar Beckett,
Travelling Inspector.
26/4/27.

6. *Question.*—Whether or not steps will be taken to import about 50 lbs. of English potatoes suitable for planting?

This was postponed.

MOTIONS BY MR. H. A. BRITTON.

1. That in the interest of developing and maintaining an Export Trade of Produce by the small farmers, it is necessary that Produce Inspectors be appointed. This was postponed.

2. That the Board recommend to Government the early introduction of legislation making it obligatory on Agents of small Farmers to keep proper books and make daily entries of all articles sold.

This was seconded by the Hon. R. E. Brassington and carried.

Mr. Beckett did not support this motion and remarked that he did not think that roguery, if it existed, could be cured by book-keeping.

3. That this Board take the necessary steps to increase production, and decrease the importation of certain articles of foodstuffs.

This was postponed.

4. That the charge for Poultry Eggs be reduced by 50 per cent.

This motion was not carried.

5. That two of the Ram Sheep be disposed of.

This was withdrawn.

6. That the Bulls be taken from place to place in the several Counties so that the small man may have their services to improve the breed of cattle.

This was withdrawn.

The Hon. R. E. Brassington laid on the table the following Resolution received from the County of Essequibo Agricultural Association :

" *Whereas* the entire District from Johanna Cecilia " to Annandale has been flooded for the past ten days and " in consequence of such flooding serious losses have been " sustained by all sections of the community, especially " Rice farmers and growers of ground provisions. "

" *And whereas* the such flooding has been caused by " the bursting of the Savannah Dams aback of Pln. Cullen " and Annandale. "

" *And whereas* the bursting of the said Dams was due " entirely to the Savannah water being unduly checked at " the Relief Koker under the right of way trench at the " Oena Creek, the said relief koker being only of 6 ft. " bore, it is obvious that is utterly inadequate to cope with " the discharge from two 12 ft. sluices and a 4 ft. " box koker. "

" *And whereas* it is necessary that a twelve ft. sluice " be put down immediately at the right of way trench " crossing the Oena Creek in place of the 6 ft. tube as a " relief from the Weirs and box koker above-mentioned."

"*And whereas* it is imperative that the Irrigation and "Drainage of the District be placed on a sound footing "and under the control of a Competent Authority."

"*Be it resolved* that this Association desires to repre-"sent to the Board of Agriculture the seriousness of the "position with a request that Government be asked to ex-"pedite the passing into Law of the proposed Irrigation "and Drainage Bill with the view to the prevention of a "recurrence of this scandalous state of affairs."

He explained that the Irrigation and Drainage Bill had already been passed.

The Chairman then adjourned the meeting to a date in May to be fixed later.

REPORT ON EAST COAST FARMERS' COMPETITIONS.

The Acting Director,
Science and Agriculture Department,

Sir,

We have the honour to submit our report on the Farmers' Competitions on the East Coast of Demerara, at Victoria, Nabaclis, Golden Grove, Friendship and Buxton.

2. In judging these Villages we were guided according to whether the competitors had been carrying out the agricultural instruction given them throughout the year.

We are pleased to be able to report that there are signs of improvement, and a considerable awakening on the part of the majority of the farmers. We were especially pleased with the work being carried on by the farmers at Nabaclis.

Special mention might be made of the tilth, that many farmers have procured in their provision beds. Such tilth could not have been secured without deep ploughing during the disastrous period of drought, when naturally all farmers were very discouraged and it took considerable labour and a great deal of grit and determination to fork these lands, when they were of the consistency of concrete.

3. We are glad to be able to report that some of the farmers in these Districts are beginning to take an interest in ground-nuts, and we have every hope of seeing a fair area under this legume during 1927. Small plots have already been planted with satisfactory results.

It is a pleasure also to report that a much greater interest is being taken in the planting of permanent crops—seedling beds with Arabian and Liberian coffee have already been started, so that we can look forward with confidence to seeing coffee being planted on some scale during the coming year. Young coconuts have also been planted, and much greater care has been given to selection of seedlings and the spacing of the palms.

Interest is also being aroused in bread-fruit and bread-nuts—the latter can readily be converted into butter and the former always commands a ready sale.

These farmers are now taking a much greater interest in pruning, and some citrus trees intelligently pruned can be observed here and there. It is interesting to note that already pruning tools have been purchased and used on co-operative lines.

4. We inspected Victoria on the 1st instant, Golden Grove and Nabaclis on the 2nd instant, whilst Buxton and Friendship were "judged" on the 3rd instant.

The following are the results—cultivation, drainage and sanitation :—

	Per cent.	
C. Poole	60	$10.00
C. Adams	58	8.00
B. Russell	56	6.00
R. Benn	54	5.00
T. Dover	54	5.00
R. Haynes	53	4.00
T. Dick	52	3.00
C. Blair	50	2.00
Prince Cuffy	50	2.00
M. Collins	50	2.00
	Total	$47.00
R. Elias	48	...
Thos. Cuffy	48	...
H. Collins	45	...
A. Wood	45	...

Nabaclis and Golden Grove.

H. Wood	77	$18.00
E. Ward	75	16.00
L. Francis	75	16.00
A. C. Baptiste	72	12.00

W. Baptiste	...	72	...	...	12.00
E. Barry	...	71	...	...	10.00
J. Baptiste	...	70	...	...	8.00
G. Cockfield	...	70	...	...	8.00
J. Lane	...	70	...	...	8.00
J. Barry	...	55	...	...	6.00
				Total	$114.00
W. Ashby	...	49	..	...	...
S. Mc Garrell	...	42	...	...	...
J. Lacum	...	40	...	...	...
J. Limerick	...	40	...	...	...

Buxton and Friendship.

J. J. Marshall	...	58	...	...	$8.00
Jaggah	...	54	...	...	6.00
H. Gill	...	52	...	...	3.00
				Total	$17.00
E. Adonis	...	48	...	...	...
T. J. Jordan	...	42	...	...	...

Total Prize Monies $178.00

Of these Villages, it will be seen that Buxton and Friendship are the most backward.

We recommend that the prizes be given as mentioned in the above list.

We have the honour to be,
Sir,
Your obedient servants,

EDGAR BECKETT,
Travelling Inspector.

C. C. DOWDING,
Agricultural Instructor,
East Coast District.

BERBICE AGRICULTURAL LIVE STOCK AND INDUSTRIAL SHOW.

By Edgar Beckett, F.L.S.

The Berbice County Agricultural Live Stock and Industrial Show, was held on the Berbice Turf Club Grounds on the 31st March and the 1st April.

The Show was organised under the auspices of the Board of Agriculture. Though a score of years have elapsed since the last County Show was held in Berbice, yet the interest awakened was most marked and complete success crowned the efforts of the Committee. We feel confident that these County Shows will be held at regular intervals and that no longer will Berbice allow another twenty years to slip away before they have their next Exhibition. Indeed if these Shows are to awaken an interest in agriculture and to give an impetus to farmers in the way of competition, it is an absolute necessity that they should be held at stated times.

There is no doubt that there is a quickening in agricultural matters, and that generally speaking, a revival in agriculture throughout the whole Colony is taking place.

The Show was opened by His Excellency the Governor, who was accompanied by Lady Rodwell and Captain Stayner, A.D.C. His Excellency and Lady Rodwell were welcomed by Mr. W. M. B. Shields, the President of the Council of Management. In the course of an excellent speech, Mr. Shields pointed out the important part these Shows could play—especially at this time when the Government had removed a long standing ground of complaint, by certain developments in drainage.

"Farming," Mr. Shields stated, "has ceased to be a conservative occupation, and farmers of to-day, whether they grow provisions or sugar canes must adopt up-to-date methods if they mean to survive."

Mr. Shields pointed out that Shows like these should really be farmers' schools and he expressed the wish that some instruction could be given at them, so that farmers

might understand why certain exhibits received prizes and others did not.

The Governor, before he declared the Show open, after congratulating the Committee on their energy and enterprise, expressed surprise at the fact that twenty years had elapsed since the last show, and hoped that the renewal of such shows was a sign of a revival and awakening of a general interest among the population in agriculture. After touching upon the importance of our staple industry, His Excellency pointed out that this importance did not mean the over-shadowing of other industries, but that there was room for development in other directions.

"It always seems to me," continued Sir Cecil, "that agriculture has a firmer foundation than other products—minerals for instance, such as gold and diamonds. When you take diamonds or gold out of a country, you are taking out your capital, but for every new acre brought under cultivation—agricultural cultivation—you are increasing your capital, and all you are taking out of your country is the interest in the form of crops and produce. Apart from the economic side, it always seems to me that there is a certain romance—I might almost say a certain poetry—about agriculture. There are many of you here who remember perhaps a little bit of your Virgil. Virgil in that splendid poem of his, told the farmers how to raise their crops, and very much of what he said in those days is proved to-day. I also remember another old Latin poet who held the same wise views on Agriculture. He was writing about gold and he said, 'Gold which is hidden in the earth is better left so.' I do not quite agree with that because I think we want to get out of our gold mines and diamond mines all the gold and diamonds we can. But there is something about Agriculture which appeals to me in a way in which gold and diamonds do not. There is a certain dignity about the pursuit of Agriculture. I consider men should be proud and not ashamed to till the soil. I perhaps speak with some feeling in the matter, because my own forebears were farmers, and I look forward, if I

survive the period of my official career, to spending the evening of my days as a farmer."

Turning from the sentimental to the practical side, His Excellency continued—"I attach a great deal of importance to the teaching of the elements of agriculture in our schools." He said that he was glad to find that at the Berbice High School for Boys and Girls, an important part was played in the curriculum by practical training, and he expressed the hope that many of the boys would go on the land.

Amongst other products, the Governor emphasised the cultivation of ground nuts. "I have been reading," said His Excellency, "all the literature I could lay my hands on on the subject of ground nuts. I have also heard a great deal about them lately from Mr. Roy Wilson, one of the members of the recent Parliamentary Commission. Mr. Wilson has an intimate knowledge of agricultural developments on the West Coast of Africa, and I was amazed at what he told me of the wealth which is being won in that part of the world from the cultivation of ground nuts ; and I firmly believe that that is a branch of agriculture which ought to be given a proper trial here." So interested is the Governor in the possible development of ground nuts that he has started to grow this legume himself.

His Excellency then formally declared the Show open, expressing the hope that it might be the forerunner of regular periodical Shows in future.

Before commenting on the exhibits we should like to congratulate the President and the members of the Committee on the excellence of the general arrangements. We also congratulate the exhibitors on the manner in which most of the exhibits were displayed and on the general quality of all the exhibits. The only complaint that can be made is that the number of exhibits was unsatisfactory. One should like to have seen a very much larger quantity of exhibits in each class, so as to help in healthy competition and rivalry.

It is pleasing to be able to report that the attendance was very large, and keen interest was taken by farmers and others in the various sections. The Militia Band added to the attraction, while the behaviour of everyone was excellent—even those who did not secure a prize, and who thought they earned one, were not heard to express any dissatisfaction with the decision of the judges.

THE EXHIBITS.

Class A. Fruits :—On the whole this exhibit, taking all the circumstances into consideration, was quite good. Mangoes were well represented, there having been some fifty exhibits. We were pleased to notice several fruit from grafted trees and we congratulate Mr. Whitehead on his display. "Bombay Yellow," "Princess Marie Louise," "Gopaul Bhag," "Sabot," "Peach," "Number XI," were amongst these. Oranges were rather poor and there were only four exhibits of Grape Fruit, which, however, were satisfactory. The Limes were only fair, with the exception of a fine exhibit of half a barrel which earned the special prize presented by Messrs. S. Davson & Coy., Ltd. There were two exhibits of Grapes, but these were not well-grown, no attempt had been made at thinning out the fruit.

Sapodillas (*Sapota achras* L.) were well represented, altogether 24 exhibits. The Soursops (*Anona muricata* L.) were just ordinary but the display of Star Apples (*Chrysophyllum Cainito* L.) was good. The Granadillas (*Passiflora qudrangularis* L.) were poor, while the other representatives of this genus were fair. Guavas (*Psidium Guajava* L.) with the exception of two exhibits of pear-shaped fruit were poor.

The display of Pineapples (*Ananas sativus*. Schult.) was fair, whilst the 8 trays of Mixed fruit were quite satisfactory. The Musk Melons (*Cucumis Melo* L.) were good but there were only three exhibits. The Water Melons (*Citrullus vulgaris* Schrab.) were poor. Breadnut (*Artocarpus nucifera* L.) and Breadfruit (*Artocarpus incisa* L.) were poor, whilst the ten exhibits represent-

ing Papaws (*Carica Papaya* L.) of five varieties were satisfactory. The Pomegranates (*Punica Granatum*, were not fully ripened but it was refreshing to see this fruit on show.

Class B. Vegetables.—The Vegetable Marrows were only ordinary. The trays of mixed vegetables certainly claimed attention, the one obtaining the second prize contained Beet, Cabbage, Leek, Artichokes, Carrots and English Tomatoes. The Pumpkins were quite good while the Boulangers (*Solanum Melongena* L.) creditable as a whole, were especially good in many instances. The first prize reflected great credit on the winner (Mr. R. R. Ross of the West Coast of Berbice) as did also the Capsicums, the first prize again going to Mr. Ross. The Peas and Beans were fair. The Bananas, Cayenne, Dwarf and Fig, might be classed as fair, Plaintains were good with the exception of the 'giant' or 'horse' variety. A fair exhibit of Ochroes displaying four varieties showed up better than the Escallots but there was a fine exhibit of locally grown Onions, exhibited by Mr. Ross.

The first prize for Cabbages showed that locally grown cabbages can be made to produce decently formed "heads." The Tomatoes were quite good, Mr. Ross again winning the first prize for a splendid display of fruit. The Cucumbers call for no special mention while Sweet Potatoes were represented by one or two well-grown tubers. Yams might be described as very fair, Eddoes as good and Tannias as only fair. The exhibit of Sweet and Bitter Cassava was very good.

There was a good display of Eggs.

Economic Products.—This section was fairiy well represented. The oils, Castor, Coconut, Kokerite (*Maximilliana regia Mart.* et Schrank), were very good—some could fitly be termed "excellent."

The 16 exhibits of Guava Jelly were for the most part up to standard, while other jams such as Pineapple, etc., were also on show and such delicacies as Guava Cheese, etc. The exhibit of Chocolate was good, some

were spoilt owing to the fact that spice had been added to the "sticks."

As usual the Meals and Starches showed how well our people understand this work. It seems a pity that such nutritious products as Plantain and Banana Conquintay cannot be exported to British biscuit manufacturers. With an analysis of the product and a few remarks on the vitamins contained, with an attractive label of the plantain tree with a tropical setting, Biscuits made from these meals might become most popular. The dried plantains and bananas were extremly well prepared and reflect great credit on those who sent these exhibits.

Cassava cakes when toasted and buttered while hot are superior to any kind of biscuit imported into this Colony. Those on show, some two dozen exhibits, certainly convinced most people that the art of making wafer cassava bread or biscuits is one in which our farmers excel.

The samples of Tapioca and Farine were quite good nor must we forget the two exhibits of Puffed Rice—these exhibits show that we might be able to do away with the importation of rusks, quaker oats and the like.

The Rice exhibits disappointed one. They were few in number and were, on the whole only fair.

With the exception of one or two samples which were ill-cured and 'green,' the 14 exhibits of Coffee, "Creole," Liberian and Robusta, were good. Most of the prizes went to Canal No. 1. Berbice farmers should remember that at one time, Berbice coffee fetched the highest prices in the markets of the world and we trust that they are making an effort (as are the farmers elsewhere) of planting both "creole" and Liberian, on some scale.

Cacao was represented by only 7 exhibits, while there were ten exhibits of Cacao Pods showing five varieties. The Ginger was good but two exhibits only were sent. Turmeric also was satisfactory, but here again only two persons sent this condiment, while there was an interesting exhibit of Guinea Pepper.

The Copra exhibit consisted of nine entries, all of which were very fair. Plantations "Blairmont" and "Port Mourant" shewed excellent samples of White and Coloured Rum, Power Alcohol and Sugar. There was no exhibit of Farmers' Canes.

An exhibit that attracted attention was that put forward by Mr. J. M. Cush, consisting of tinned pine-apples, tinned sausages, both open for inspection, and various tinned products such as ochroes, tomatoes, etc. He also exhibited specimens of locally cured salt beef and salt pork.

There was an excellent exhibit by the Creek lands Rubber and Produce Coy., Ltd., of Raw and Concentrated Lime Juice and Distilled Oil of Limes, together with fine specimens of Para Rubber — all neatly and attractively shewn.

Copraline also found a place whilst Honey, Wax, Cherry and other Jams, Hot Sauce, Pickles and Marmalade, were all worthy of praise. The Cassareep exhibited impresses one with the possibility of an export trade being built up in this product, which is said to be the basis of most sauces.

Ground Nuts (Arachis hypogaea L.) were represented by nine exhibits, some of which were well grown. A special prize was given by the Governor in connexion with this exhibit.

The samples of Desiccated Coconut were satisfactory though few in number.

The Bread, Cakes and Biscuits, proved that our local manufacturers know their work.

Altogether this section was a credit to the exhibitors.

Class D.—Handicrafts and Works of Art.—The Fancy Work was good as is usually the case. With regard to handicraft there were on view good specimens Mats, well-made Walking Sticks all of native woods, an Inlaid Tray by Mr. J. C. P. Winter, composed of fourteen different woods was much admired, while a card table by Mr. D.

Melville (New Amsterdam), deserved the first prize which it received. Mrs. Fanny Howard's fish scale work was so well done that it secured an extra prize.

Credit is due to the Lutheran School for its cabinet work—the lining of the crab wood (*Carapa guianensis Aubl.*) chest-of-drawers was made of Sandbox (*Hura crepitans L.*), this exhibit secured the second prize.

There were Hats made from the leaflets of native palms, Flower Pots, Boots, Slippers, Hammocks, Washing Pails made from Wallaba (*Eperna falcata* Aubl.), Straw Brooms, Baskets, Barrels, an attractive Clock, specimens of Blanco, a collection of Steamship models, models of house and cottage, very excellent Scrubbing Boards and even Kites were not absent. Special mention must be made of the very excellent brass work sent in by Mr. Sabsook of Rosehall Village.

Altogether this section was highly interesting and reflected the greatest credit on all concerned.

The Government Model Exhibit was staged in the usual pyramidal form, displaying various fruit and other economic plants in baskets, and neatly arranged glass jars containing products ranging from coffee and padi to Muscat pods. The fibres were interesting containing specimens prepared from (*Sansivieria guineensis* Willd.), *Furcroea* sp., *Agave americana* Linn., and *Urena lobata*.

An interesting innovation was the exhibiting of White and Brown Leghorns and eggs. Many eggs were purchased at once by visitors.

The display of a well prepared poster with a few simple notes on *Brassolis sophorae*, showing the habits of the caterpillar and damage done to the palm was a most pleasing feature, as was also the specimens and notes concerning the habits and control of Cushi Ants (*Atta cephalotes*), cockles (*Strategus alœis*), the sweet potato weevil (*Cylas fornicarius*) and the Cassava Hawk Moth, (*Errynis ello*). This exhibition, the work of the Government Biologist, deserved a more prominent position and we suggest that at other Shows a separate space be set aside for

work of this nature, as it is of the utmost importance to the Farmer.

Another innovation was the selling of the Board of Agriculture's *Journal*, over 100 copies of which were purchased by farmers whilst the names of new subscribers were added to the ever increasing list.

Other Government Exhibits included a collection of capsicums from the Botanic Gardens, ground nuts and a fine pumpkin from the Government Industrial School, Onderneeming, whilst the District School Gardens showed some straw brooms with specimens of the *sorghum* from which they had been made.

The Needlework, we understand, was satisfactory, and was also the Fancy Work in Class E.

With respect to the Live Stock, Dr. S. N. Bruce, the Acting Government Veterinary Surgeon, tells us as follows :—

"With the exception of the horses, the live "stock exhibited impressed me favourably. The "Herefords, exhibited by Mr. J. H. Haley, "were of exceptional merit—style, conforma-"tion, quality of bone and colour were all "what they should be."

"The beef animals were the best I have seen in "the Colony. The oxen also were of a high "grade."

"The Swine, exhibited again by Mr. J. H. Haley, "of Tamworth breed, compared favourably "with the original animals imported by the "Department of Science and Agriculture."

"The sheep (Southdowns) exhibited by Mr. E. "Hicken, were of great merit. Mr. Hayley's "Shropshires also call for special mention. "The goats were very poor."

"Since the importation by the Department of "Science and Agriculture of Stallion Jacks,

"the class of donkeys throughout the Colony
"has improved. Those exhibited were of a
"high standard, and compared favourably
"with imported animals as to height, confor-
"mation, bone and style."

"The feathered stock consisted of turkeys, fowls,
"ducks and pigeons. The poultry, on the
"whole was satisfactory, but unfortunately
"only one to two breeds were on show. The
"ducks were of a high standard, but only two
"breeds were exhibited."

"The pigeons, a few pairs of which were exhibit-
"ed, consisted of the Runt and Homer
"crossed—the birds were large and showed
"signs of great powers of prepotency and re-
"production."

Reference must be made to the exhibit of the Singer's Sewing Machine Coy. Three models were on show, one of each equipped with an electric motor. Various stages of machinery, needle and embroidery work, were demonstrated by an instructress from Georgetown. There were several dresses, locally made, showing the delicacy and intricacy of the beautiful embroidery work of which these machines are capable. There was also an elaborate display of silk embroidery work from the New York Office, and also fancy Renaissance Lace work. Mr. J. Jardim, the local manager, must be congratulated on the excellent display he put up.

The Educational Section, under the care of Messrs. de Weever, Taitt and Bannister, of the Educational Department, demanded the careful attention of all. The Oxford Picture Reading Cards, the methods adopted for teaching children the counting of money, sound boxes ranging from loud and harsh sounds to faint and gentle, the child being taught to arrange them according to degrees of sound. Shape and form, taught by metal discs, various forms of straps, buckles—letters taught by touch and sight, arrangements of colour in cubes, on rods,—in short a very fine display of the Montesori system.

With respect to the Section devoted to the school children themselves, the children's contributions were very creditable. Special mention might be made of the work of the Rosehall School and the really splendid basket netting of bottles, from Barra-Carra School on the Canje river. The Hammock-making from the Hopetown Congregational School must also be mentioned, as well as the rope and mats made from a species of *Cyperus*, from the Newmarket (Corentyne) English School.

The prize for the best all-round exhibit was secured by Mr. M. Nathoo of the Rosehall Scots School, Corentyne, the second prize being won by Mr. A. Babooran of Albion, Canadian Mission School.

In conclusion, we repeat Mr. Shield's pertinent question, "We have," he said, "a fair collection of exhibits to-day, but can these be supplied to us in quantities for our daily consumption ?"

BETERVERWAGTING AGRICULTURAL, LIVE STOCK AND INDUSTRIAL SHOW.

By Edgar Beckett, F.L.S.

The Beterverwagting Agricultural, Live Stock and Industrial Show was a distinct success, and the President and Officers of the Beterverwagting-Triumph Farmers' Association are to be congratulated on their work. The Show was held on 20th April at the Anglican Schoolroom, and was opened by His Excellency the Governor, Sir Cecil Rodwell, who was accompanied by Lady Rodwell. His Lordship the Bishop of Guiana, the Chief Justice, The Honourable the Colonial Secretary and Mrs. Douglas-Jones, and the Honourable the Attorney-General were amongst those who were present.

Mr. J. R. W. Straughn, the President of the Association, in welcoming the Governor and Lady Rodwell, referred to the fact that without the Drainage Scheme pro-

vided by the Government, there would have been no Show. He assured His Excellency of their gratitude to the Government for the success of the scheme. He pointed out that the district was essentially an Agricultural one, and that recently they had started a co-operative movement amongst the farmers in connexion with the cultivation of ground nuts. His Excellency in the course of his speech congratulated the exhibitors on the way in which they had put up their exhibits—"I hope," he said, "you will observe that I have brought with me our new Colonial Secretary, a gentleman I may say, who has done a great deal for agriculture in other colonies, and I believe he is going to do a great deal to help you here."

His Excellency stated he had been most favourably impressed by all he had seen and he believed he had seen every one of the exhibits, the quality and quantity of which were quite remarkable. "I can only feel regret," continued His Excellency, "that a larger sum was not available for distribution in prizes. But as you know very well, we are passing through a lean period financially, and there is not very much to spare just now. I am quite sure that the Combined Court—I hope some of the Members are here to-day—fully realised that money voted for prizes in Shows of this sort, is money well spent."

The Governor also mentioned his appreciation of the fact that a prize had been given for the best kept private garden, and expressed his determination to see the garden which had secured the first prize in the Village. With respect to the marketing of produce, the Governor pointed out that the importance of this question was fully realised by the Government, but that there was one thing the Government must have and that is co-operation amongst the producers themselves, and he was very glad to learn that co-operation had given the villagers a start in the line in which he was particularly interested, and that was the matter of growing ground nuts.

He heartily congratulated the Association on their organisation of the Show and formally declared the Show open. Lady Rodwell was then presented with a bouquet.

Mr. H. Aaron Britton added his congratulations, referred to certain difficulties and the question of the marketing of produce, and called for three cheers for His Excellency, Lady Rodwell and their children.

THE EXHIBITS.

The exhibits were numerous, well put up and on the whole exceedingly well arranged.

Fruits.—These were on the whole fair. Three exhibits of the eight sent of Sweet Oranges were very good; the one exhibit of Tangerine was poor, whilst the Seville Oranges were very fair, as were also the Shaddocks, Grape Fruit, Lemons and Limes. Exhibitors should bear in mind that no scale insects should be allowed to remain on their citrus fruits. The Sapodillas, of which there were twenty exhibits of several varieties, were good, two being excellent. The small exhibit of Soursop was fair. Thirteen very good exhibits of Starapples and the same number of Pineapples, all very fair, were followed by ordinary exhibits of Custard-apples, Guavas, Water Melons, Musk Melons and a poor exhibit of Granadillas. The trays of mixed fruit were ordinary, while the two exhibits of citron were poor, but the twenty exhibits of husked coconuts call for special mention, many of these being excellent. Bread-fruit, Jack-fruit and Papaws were fair. There was quite a good show of Pomegranates, as well as three baskets of Sidiums.

The Bananas made a splendid exhibit. There were fifteen exhibits of the variety known locally as 'The Fig,' one of the 'Buck,' seventeen of the 'Dwarf,' and eighteen of the Cayenne variety—these being very good.

There were sixteen exhibits of Mangoes which were, on the whole very fair.

Vegetables.—Plantains were represented by three good exhibits of 'Giant' and nine exhibits of others. The Yams,—Buck, White and Purple, were very fair, whilst thirty exhibits of Bitter and Sweet Cassava were very fair, as were also the fourteen exhibits of Tannias and Eddoes and the twenty exhibits of Sweet Potatoes. There were

two uncommon varieties of Pumpkins, the fourteen exhibits of which, (there had to be three to each exhibit), made quite a brave show—four varieties were represented. Three varieties were to be seen amongst the eight exhibits of Vegetable Marrow or Squash and six exhibits of Tomatoes of which one only was good were succeeded by quite a number of well grown Eschallots. The Lettuce and Cabbage were both poor, but the exhibit of Onions, though small, was excellent, The peas and beans included "Black Eye," "Pigeon Pea," and "Bonavist," it was pleasing to note no less than forty-two exhibits.

Three varieties of Ochroes were to be found in the seventeen exhibits. The twelve exhibits of Capsicums were attractive. Coffee was represented by Arabian, Liberian and Robusta—16 exhibits, all very fair, as were the eight exhibits of Cacao. The Ginger, of which five exhibits were shewn, was satisfactory with one exception. The Ground nuts were quite good. The first prize went to the District School Garden of Belfield, the second prize to Mrs. McGarrell of Golden Grove, and the third prize to Mr. Robinson of Enmore.

The Indian Corn was good, thirteen exhibits were on show. The condiments included Turmeric and Guinea pepper. The Rice exhibits were very fair, both Brown and White. Of the padi, two were good samples. The Meals were all in splendid condition—no less than ninety-eight exhibits were displayed in this class. There were thirty-two exhibits of Starches all very good, whilst Tapioca and Farine accounted for thirty-five exhibits. These exhibits of starches, meals tapioca, etc., were all good and it is to be hoped that the exhibitors,—if a market is found for products of this kind—will be able to supply them in commercial quantities.

Thirty-five exhibits of Cassava Bread and nine exhibits of Cassareep shewed that the villagers know how to prepare these articles. There were fifteen samples of Copra, two of which were distinctly good.

This section included Orange, Jamoon and Ginger Wines, Hot Sauce, Guava Jelly, (20 exhibits); Pine Apple,

Papaw, Golden Apple, Tomato and Mango Jams; Guava Cheese, Tamarind Syrup, "Fly," and two exhibits of Tobacco, while Dried Shrimps and Desiccated Coconuts elbowed each other for room, so numerous were the exhibits sent in under this Class. The oils,—Coconut, Castor and Awarra (*Astrocaryum Tucumoides*) were a good collection; the Chocolate was good whilst the small exhibit of Honey was only fair. Preserved Duntes (*Zyzyphns Jujuba*) said to be a substitute for Olives, was a rare exhibit.

Pickles were fairly well represented and there were samples of very well made Curry Powder—the first prize went to Mrs. Gonsalves of Triumph.

The large exhibit of Bread, Biscuits, Cakes, etc., was most creditable. A special feature of this Show was a splendid display by the well-known firm of Wieting and Richter of their excellent Soda Biscuits. These local biscuits (samples of which were distributed to many persons) are attractively and neatly put up in tins, 2½ lbs. nett. These biscuits afford an opportunity to farmers and others of supporting local industry. Possibly in the near future this firm which has already done so much to foster local industries, might be able to utilise some of the starches and meals, such as cassava, rice flour, etc., which are produced by our local farmers.

Class E.—Needle and Fancy Work attracted a large number of competitors, whilst Class D. certainly added to the appearance of the School Room, some of the ferns being well-grown.

Only three exhibits of Farmers' Canes were on show, Sugar Cane and its products were practically unrepresented.

The School Children's Section was quite creditable, consisting of models in paper, card-board, etc., basket-making, drawings, hat-making, etc.

The Special Section consisted of various articles from Flower pots to shoes. Six prizes were awarded here, one for the flower pots, one for a well made hammock (gained by the children of the R.C School, Main Street), one for an excellently made trunk, one for a good sample of cotton,

one for a sample of fibre, while a straw broom made from locally grown broom corn also gained the recognition it deserved.

Live Stock.—The Board of Agriculture exhibited two fine bulls, one Holstein-Freisan and one Devon, both in excellent condition, in spite of the fact that the latter had recently recovered from an attack of Pneumonia. The Board also exhibited White and Brown Leghorns and Indian Runner Ducks.

The exhibit of Live Stock on the whole was satisfactory with the exception that not a single horse was sent in.

Dr. Bruce, Acting Government Veterinary Surgeon states with regard to this section :—

> " There was one Bull exhibit—poor in type—the " heifers and steers were on the whole good, " the donkeys again established the fact that " the importation of Stallion Jacks by the " Government is bearing good fruit. The " Ram Sheep exhibited by Mr. Wiltshire was " one of the best creole rams ever seen in this " Colony ; the Ram Goats, few in number, " were ordinary."
>
> " The feathered stock call for no special mention, " except two capons which were in good " condition."

One would have liked to have seen a larger number of exhibits in this section. There was a deer on view as well as a pair of labbas (*Hydrochoerus capybara*). Labba 'farming' might possibly prove quite a lucrative business to be engaged in. There was a very large and fair exhibit of eggs—thirty-two entries of a dozen each took up considerable space.

The Government Model Exhibit was practically the same as that displayed at the recent Berbice County Show. It attracted considerable interest. There were some well grown corn and peas from the Government Industrial School, Onderneeming, and mats and ropes from the Georgetown Prison. The poster on the Coconut Caterpil-

lar and specimens of insects, were well in view and certainly proved interesting to the farmers.

The Singer's Sewing Machine Coy. again made an excellent display and as at The Berbice County Show, attracted the attention of numbers of visitors, Mr. Jardim, the local Manager, making this exhibit most interesting.

These District Shows, as forerunners of the County Shows, should prove of use in making the more important Shows well represented Exhibitions.

With respect to the District School Garden Section, I would suggest that at these District Shows, substantial prizes be offered for the best exhibition of manual work performed by the school children—in this way any idea that may be lurking in the minds of children that field work is undignified, may be dissipated.

NOXIOUS WEEDS.

By Edgar Beckett, F.L.S.

Most countries have to face the question of either the subjection or the eradication of noxious weeds. Unfortunately in British Guiana, hitherto, there appears to have been a *laissez-faire* attitude—an attitude which the disastrous growth of the pernicious and dangerous species of *Antidesma* has altered.

The plant has escaped from control. The damage that can be done by this pest can readily be seen by anyone who takes the trouble to visit *Le Repentir* Cemetery, New Town, The Lodge Village and other places contiguous to the Botanic Gardens.

The eradication of annuals which reproduce themselves from seeds alone, is not a difficult matter, but a plant like *Antidesma*, which reproduces itself, not only from millions of seeds, but also tillers and shoots from any portion of broken root, every such shoot growing into a robust plant, whilst any scattered

joints however small, if allowed to remain also grow into vigorous plants, each in its turn producing more seeds and more root-stocks ; a plant pest such as this, presents a problem pregnant with difficulties, even at control, not to mention subjection or eradication.

The species of *Antidesma* to which we have referred will send out roots 50 feet in length and to a depth of six feet.

This pest has now forced itself upon us as a menace and one of grave danger.

"Prevention is better than cure" is a very old and hackneyed adage, but it has lost none of its force to-day.

Any early appearance of this pest, if tackled at once, will keep this enemy out of pasture or cultivated area easily enough, but if it is allowed to escape from control, the loss of unoccupied and pasture lands will be very great, whilst cultivated areas might have to be entirely abandoned if the march of destruction is allowed to go on unmolested.

It is advisable for everyone of our cultivators to view with suspicion any strange plants that he may see shooting up in his fields. One has only to refer to Para grass (*Panicum barbinode*), probably introduced from Africa, which, had it been kept out of sugar and other cultivated lands, would have saved hundreds of thousands of dollars and many numbers of years of labour. The Bahama grass (*Capriola dactylon*) is another example—instances are not unknown in which this grass has actually beaten the cultivator.

It is to be hoped, therefore, that every planter and farmer will see to it that this species of *Antidesma* is not allowed to sneak its way into any of his lands, eventually to become a persistent and pernicious pest.

It must be remembered that what may not be a pest in one country, may, on its introduction to another country, prove a most serious source of danger—this

is not only true with respect to plants but also to animals. In 1919, the Fijian Government brought to the notice of the Imperial Department of Agriculture and also to the Government of British Guiana, the seriousness of the pest known as Koster Curse," *Clidemia hirta*, one of the *Melostomaceae*, a common plant in British Guiana and the West Indies from Trinidad to Jamaica. In this part of the world it gives no more trouble than any other melostomaceous plant and is not a source of any worry at all.

Introduced into Fiji however, it has been found an agricultural pest and is a curse to cultivators. On the other hand, *Antidesma Dallachyanum*, known as "The Herbert River Cherry," is found amongst the flora of Wooroonooran, Australia, where it fruits heavily and is made into excellent jam or jelly.

There are other plants which, though not perhaps a serious pest with us, are so threatening a danger to agriculturists that legislation has been introduced in connexion with the control or suppression of such plants. For example, in Ceylon, the Water Hyacinth (*Eichornia* sp.) has became a serious nuisance and has been declared a 'weed' under the Plant Protection Ordinance and the Department of Agriculture has been definitely charged with its eradication from the Colony. This weed has been the cause of serious damage in many countries. In Bengal, Burma, Indo-China it has became a menace. Mr. Stockdale, the Director of Agriculture, Ceylon, is determined that it shall not be allowed to race riotously over Ceylon, and in the December issue of the *Tropical Agriculturist* appears a strong appeal from his pen against this Water Hyacinth menace.

There are other plants in this Colony which we have noticed show signs of beginning to become a source of danger. One of these plants which is a considerable nuisance, is called in some parts of the Colony, "Wild Coffee" (*Clerodendron siphonanthus.*)

This plant roots deeply and it is making its unwelcome presence felt in many parts of the county of

Demerara. We strongly advise that a check be given to its advance and every effort made to eradicate it on its very first appearance. So marked is the damage done by this pest that many cultivators have been under the impression that this pest is the antidesma pest, concerning which the writer drew up the following Notice for the Official Gazette of 5th August, 1926.

WARNING TO FARMERS.

NOXIOUS WEED.

Cultivators throughout the Colony are warned to keep a very sharp lookout for a noxious weed known as *Antidesma*, the common names are :—" Congo Weed, " " Sour-Bush, " " Black Tongue, " " Worthless Bush "— and " Wild Jamoon." This plant, at a distance, does not look unlike a guava bush, but on closer examination it is quite unlike guava, the leaves are, unlike guava, alternate and smooth.

At a distance also, to a casual observer, young shoots of Jamoon do not look unlike young *Antidesma*, but actually the two plants are not alike.

It grows into a tree some twenty feet high, produces many thousands of flowers. The flowers are inconspicuous and are borne on spikes. The fruit is a little red berry something of the colour of a " black sage " berry, which later turns dark, almost black, in colour. Birds eat the fruit and so spread the pest. Children are very fond of the sub-acid flavour of the fruit and suck the little berries readily.

The plant spreads exceedingly rapidly, not only by seeds but by root suckers. The smallest piece of root left in the ground will grow and spring up into a sturdy plant.

At its first appearance it should be carefully dug up, all the roots removed, and the whole burnt.

Those farmers and cultivators who do not know the plant should visit the Botanic Gardens, Georgetown, where a specimen will be shown them by the authori-

ties, after which they should visit the north-eastern section of Le Repentir Cemetery—and see for themselves the dreadful wholesale destruction that can be wrought by this noxious and pernicious weed. Once it is thoroughly established it is almost impossible to get rid of it."

The genus *Antidesma* belongs to the large order *Euphorbiaceae* and contains about 200 species. It is a tropical tree or shrub, the leaves are simple and entire, the inconspicuous yellow flowers are borne on spikes, unisexual, whilst the fruit is a little round one-seeded drupe, first green, then a pretty red, turning at a later stage dark to almost black in colour.

Apparently it flowers and fruits the year round, the writer has seen a few flowers as late as September, and as early as March. The fruiting is prolific. Birds readily eat the fruit and so disperse the seeds. Children are extremely fond of the fruit—the sub-acid taste appealing strongly to them. They gather huge quantities of fruit and they also help to disperse the seed. When it is remembered that pieces of root ½ an inch long, if left in the ground, grow readily into sturdy plants, that it tilters and suckers in a most alarming fashion, it will be seen how desirous it is to check the disastrous work this plant is now carrying on. In some localities large areas are already hopelessly ruined.

Clerodendron siphonanthus belongs to the order *Verbenaceae* and is of course entirely unlike *antidesma*. It is well-known to most of our readers by the name of "Wild Coffee."

This plant must not be confused with *Clerodendron aculeata* also known as "Wild Coffee" and which is so useful as a hedge plant.

A species of *Flemingia*, known in Demerara as "Wild Cacao," is also proving itself a nuisance to some farmers; this plant is not to be confused with the "Wild Cacao" of the rivers (*Pachira aquatica*) *Flemingia* belonging to the *Leguminoseae*, one would

not have thought could have proved itself a pest, but though it is a leguminous plant, it certainly is a worry to many farmers.

The plant known as "Baby Jamoon," apparently a species of *Eugenia*, can be quite troublesome, and farmers and others on the West Coast of Demerara would be well-advised to keep this plant out of their cultivation. A species of *Mucuna* is also becoming a pest in the Mahaica District.

In Volume XVI of September 22nd 1917, *The Agricultural News* under the caption of "A noxious Weed" referred to the fact that, in the West Indies there were to be found many wild species of the genus *Amaranthus*, amongst them the vigorous weed known 'as prickly caterpillar' (*Amaranthus spinosus.*) The article in question continues "In the pastures near Honolulu, Hawaii, this weed has spread so extensively as to cause the Board of Agriculture and Forestry to issue warnings to ranchers against this obnoxious plant, advising the use of every possible means to prevent its further spread."

In March, 1921, this same publication pointed out to growers in the West Indies in general, in an article entitled, "Weeds as pests and their suppression" that "very often there is a tendency to neglect a weed on its first appearance until its spread has become alarming."

The article pointed out that when the plant pest known as the Russian Thistle was first observed in California, had vigorous action been taken followed by persistent watchfulness to avoid new infestations the state might have been freed of this pest, but in spite of all warnings the weed was allowed to spread until it covered "the southern half of California and a large area of the northern part."

In the Canje river the mass of weeds known as "Missouri grass," is a serious menace to navigation, and has cost many thousands of dollars. The mass

of grass consists of *Panicum amplexicaule* and other aquatic plants. *Telanthera philoxeroides*, *Polygonum glabrum* and *Ipomaea aquaticea* with sub-aerial creeping stems. In our rice lands a species of *Jussiena* is found very frequently and though at present it is not a source of any danger it should be eradicated at once.

It will be seen that certain plants can prove to be a source of real danger to the Colony. Ranchers may find large areas of pastoral land utterly useless for grazing purposes, if certain noxious weeds are allowed to escape from control.

It behoves all agriculturists to keep a keen watch on plants which give any indications of being a pest either in their cultivated areas, their pasture lands, or in navigable waterways. By taking action at once, a saving of years of labour and large sums of money may be the result.

On the other hand, a careless attitude may result in a weary waste of years of labour and the expenditure of very large sums of money, with possibly the abandonment of areas of land which would, otherwise, have been beneficially occupied.

It is not a pleasant sight to witness areas of useless "bush" growing on lands which might be supporting numbers of cattle, or smiling with crops of sugar or rice.

Everyone of our farmers must do his share in keeping in check weeds which are potentiascourges.

GINGER.

Its Cultivation and Preparation.

The following is an extract from an Article on Ginger, its Cultivation, Preparation and Trade, in Vol. XXIV No. 4, of the Bulletin of the Imperial Institute.—Editor.

The bulk of the world's supplies of dried ginger is at present produced within the Empire, in the West Indies, India and West Africa. Jamaica ginger is of a relatively uniform high grade. Indian ginger is on the whole of somewhat lower quality, although certain kinds, such as Calicut ginger, realise prices approaching those of Jamaica ginger. The ginger produced in Sierra Leone, however, which forms a very large proportion of the material imported into the United Kingdom, is of a lower grade. The Imperial Institute is informed that the United Kingdom market could absorb increased supplies of ginger of the better qualities, and for this reason it has been considered desirable to draw the attention of present and potential producers to the best methods of cultivating the plant and preparing the product for the market. In the case of Sierra Leone and Dominica this has already been done to some extent by means of a memorandum sent recently by the Imperial Institute to the respective Governments of those countries. Through the agency of the present article, it is hoped to create an interest in the product in other parts of the Empire, where the conditions are suitable for its production.

The Ginger Plant.

The ginger of commerce consists of the underground stem or rhizome of a herbaceous perennial, *Zingiber officinale*, Roscoe, belonging to the natural order Zingiberaceæ, a section of the Scitamineæ. The rhizome is branched and bears at intervals upright leafy shoots, about 2ft. high, and, usually distinct from these, an erect flowering shoot.

From very early times the plant has been grown from cuttings of the rhizome and, like certain other plants which are propagated entirely by vegetative means, such as the banana, fertile seed is rarely produced. The cultivated plant consequently shows little variation in botanical characters and the various forms of ginger which appear on the market owe their differences almost entirely to the method of cultivation and preparation practised in the region of production. It was at one time stated that the relatively juicy Canton ginger, from which the Chinese preserved ginger is prepared, was derived from a distinct though related plant, *Alpinia galanga*. This, however, is now known to be erroneous, and the succulence and slight pungency characteristic of Chinese ginger appear to be due to the special methods of cultivation adopted in China and to the rhizome being harvested at a comparatively early age.

The original home of the ginger plant is not known with certainty. It occurs wild in South-east Asia and in the Malay Archipelago, and it has also been recorded in a wild state in Colombia. It has been suggested, however, that the plants found in Colombia are relics of early cultivation, as may possibly be the case also in the other two regions mentioned.

CULTIVATION AND PREPARATION.

Climatic Requirements.

For the successful cultivation of ginger the essential requirements as regards climate are a good rainfall and a high temperature during the growing period. In the ginger-growing region of Jamaica the mean annual rainfall is 88 in., whilst in south-west India it is over 100 in. A dry season during the resting period and prior to planting is an advantage, as it facilitates the thorough preparation of the soil required for the crop, but is not essential.

Owing to the fact that a high temperature is needed for the optimum growth of the plant, cultivation is naturally most successful in tropical and sub-tropical regions.

It need not be restricted to such areas, however. Provided that the heat and sunshine are sufficient during the greater part of the year, a cold winter is immaterial, as before this period is reached the rhizomes will have been dug up from the ground, the bulk already prepared for the market and the remainder stored for planting the following season. These are actually the conditions obtaining round Canton and also in parts of Queensland where the crop is grown.

As regards altitude the plant succeeds in Jamaica from sea-level to considerable elevations, and in India also it is grown both in the low country and up to ·4,000—5,000 ft. in the Himalayas.

Soil and Manure.

Ginger is an exhaustive crop and, unless manures are readily and cheaply available, the soil in which it is grown must be rich in plant food. The plant will not succeed in land liable to become water-logged or in soil of a gravelly or very sandy nature. The most suitable kind of soil, therefore, is a rich vegetable loam. The land must be well drained, as if water collects about the rhizome the latter is liable to rot.

The best varieties of Jamaica ginger are grown on a sandy loam, and in India the ginger produced on the compact black soils is said to be inferior to that grown on the lighter sandy loams. The amount of sand should probably be not more than 30 per cent. and of clay not above 20 per cent.

The principal constituents removed from the soil by ginger are stated to be lime and phosphoric acid, and it is the replacement of these constituents which should be aimed at.

Cultivation.

In Jamaica two methods of cultivation are adopted. That by which the best ginger is obtained consists in planting in March or April portions of selected rhizomes from the previous year's crop, care being taken that each

portion planted contains an "eye" (embryo stem). The land is raised into ridges and the pieces of rhizome are placed a few inches below the surface and about one foot apart, the process being much the same as that observed in planting potatoes. It is advisable thoroughly to clear the land of weeds before planting the rhizomes, as the removal of weeds becomes difficult later on when the ginger plants have developed. Unless the rainfall is good it is necessary to resort to irrigation, as the plants require a good supply of water. The ginger produced in the foregoing way is known as "plant ginger."

"Ratoon ginger" is obtained by leaving in the soil from year to year a portion of a rhizome containing an "eye." This "eye" develops in the normal way, giving rise to a supply of rhizomes in the succeeding season. "Ratoon ginger" is smaller and contains more fibre than "plant ginger," and the product obtained by this means is said to deteriorate steadily from year to year.

In some parts of India it is usual to plant the crop in beds about 10 to 12 ft. long and 3 or 4 ft. wide, in which the sets are placed about 9 in. to 1 ft. apart. The field is then covered over with the leaves of trees or other green manure to keep the soil moist, and over the leaves organic manure is spread to a depth of about ½ in. At the end of the rainy season it is necessary to resort to irrigation. During the first three months of the dry season the field is weeded about three times.

Before planting, the land must be thoroughly hoed (or ploughed) and harrowed, in order to produce a fine tilth. In planting large fields it would appear preferable to open up drills about 1 in. deep and 2 ft. apart, much as is done in planting potatoes on a large scale. Artificial manure, such as superphosphate and bone meal, can then be incorporated in the soil at the bottom of the drill, before planting the sets.

On account of the crop taking up such large quantities of plant food a system of rotation should be adopted if possible. This is done in some parts of Jamaica, where much of the ginger is grown in small quantities as a garden plant, in association with bananas, chillies, etc.

The method of growing ginger in the Canton district of China differs considerably from that practised in countries where dried ginger is the objective. Low-lying ground is usually selected for the crop and the cuttings are set at intervals of 6 in. in ridges about 1 ft. high and 2 ft. apart. Water is kept continuously between the ridges. After the shoots have reached a height of from 6 in. to 1 ft. the plants are heavily manured at frequent intervals with urine or nightsoil mixed with water. This favours the formation of the succulent rhizome characteristic of Chinese ginger.

"Ratoon ginger" matures early, and in Jamaica is harvested from March to December; but "plant ginger" is not ready for digging until December or January, the rhizomes being gathered as they mature from that time until March. The rhizomes are known to be ready for digging when the stalks wither, this taking place shortly after the disappearance of the flowers. In Jamaica the plant flowers during September. The rhizomes are twisted out of the ground with a fork or a hoe. In performing this operation great care is necessary, as any injury inflicted on the rhizome depreciates its market value. Considerable experience is necessary in order to lift ginger rhizomes properly.

The "hands" (complete rhizomes and adherent fibrous roots) are piled in heaps, the fibrous roots are broken off, and the soil and dirt removed immediately, as otherwise it is difficult to get the finished ginger white. The rhizomes should not be allowed to lie long in heaps, as they are liable to ferment. The usual plan is, as soon as the rootlets and excess of soil have been removed, to throw the ginger into water to be ready for "peeling" or "scraping." This is done in Jamaica by means of a special knife, consisting merely of a narrow straight blade riveted to a wooden handle; in India the outer skin is scraped off with a shell or piece of broken earthenware. In the case of Sierra Leone ginger of the ordinary grade, the flat sides of the hands are scraped with a spoon and the hands are then laid out to dry without washing in water.

The operation of peeling, if carried out in a proper manner, is a very delicate one, the object being to remove the skin without destroying the cells immediately below it, since these cells contain much of the oil upon which the aroma of the best qualities of ginger depends. As the rhizomes are peeled they are thrown into water and washed ; and the more carefully the washing is done, the whiter will be the resulting product. As a rule the peeled " hands " are allowed to remain in water overnight. Some planters in Jamaica add a small proportion of lime-juice to the wash water at this stage, at the rate of about half a pint to six or seven gallons of water, in order to produce a whiter root.

After washing, the peeled rhizomes are placed in a " barbecue," which consists merely of a piece of levelled ground covered with cement, on which the ginger is placed to dry in the sun. Where a " barbecue " is not available, a " mat " consisting of sticks driven into the ground, across which are laid boards or palm or banana leaves, is used, on which the ginger is exposed until it is dry. Uniform drying of the rhizomes is essential for the production of first-class ginger and to prevent mildew ; and to ensure this they should be separately turned over by hand at least once on the first day. Careful planters put their ginger out daily at sunrise, and take it in each night at sundown ; conducted in the latter way the operation of drying usually takes from six to eight days. The ginger, if not sufficiently white in appearance, has to be bleached by further washing, and after being re-dried is ready to be packed for export. In some parts of India the peeled rhizomes are bleached by soaking in lime-water for a short time and exposing them for about 12 hours after drying to the fumes of burning sulphur in a specially constructed bleaching-room, at the rate of 7 lbs. of sulphur per ton of rhizomes.

The finished ginger is graded according to size and colour of the " hands "—the best grades consisting of the large plump " hands " free from traces of mildew, and the poorest, the shrivelled, dark-coloured " hands." As a rule

the crop is divided into four or five grades. The best "hands" obtained in Jamaica weigh as much as 8 oz., 4 oz. being an average weight.

Unpeeled ginger is merely freed from its rootlets and excess of soil, and then thoroughly washed in water or scalded in a boiler of hot water, and finally dried in the sun.

Preparation of Preserved Ginger.—In China the first crop of ginger is ready about three months after planting. This is known as "young ginger" and is the least pungent and most expensive. Unlike the Jamaica and Indian ginger, the rhizomes are not allowed to mature, as they become too pungent for the purpose for which they are required. After harvesting the roots are washed and the skin carefully scraped off. They are then punctured by means of a fork and afterwards washed in rice water (the water left from washing rice) to improve the colour. The rhizomes are next boiled in three or four changes of refined sugar and water for one or two hours, until thoroughly soaked. They are then placed in barrels or other containers and covered with syrup. In the case of dry preserved ginger, the wet rhizomes are strained till dry and then rolled in sugar placed on bamboo matting.

Yield.—The yield of ginger varies considerably with the climate, soil, and methods of cultivation employed. In Jamaica the average return is from 1,000 to 1,500 lb. of dried ginger per acre, but as much as 2,000 lb. per acre has been obtained under the best conditions. The recorded yields in different parts of India vary within wide limits. In Bengal it is stated that 1,000 to 1,500 lb. per acre is the average crop, in the Punjab 2,100 lb., in Travancore 2,000 to 2,500 lb., whilst in an experimental cultivation at Surat, Bombay Presidency, the yield was equivalent to over 8,000 lb. per acre. As already mentioned, a yield equivalent to nearly 3,000 lb. per acre was obtained in Jamaica on exhausted land by the application of a suitable manure; and there is no doubt that, by careful cultivation and manuring, the yield in all the countries mentioned

could be considerably increased. It takes about 4 tons of freshly dug rhizomes to give one ton of dried ginger.

Pests and Diseases.—Owing to the pungent nature of the shoots, the ginger plant is attacked by very few insect pests, and it has even been recommended that the crop should be planted in orchards to prevent the development of pests of fruit trees.

Considerable injury is inflicted on ginger crops in Jamaica by a disease called "black rot," which attacks the underground parts of the plant, and brings about decay of the rhizomes. The first indication of the disease is a yellowing of the leaves, which droop and wither; the bases of the stems become discoloured and rot, and finally decay spreads to the rhizomes, which disintegrate to form a putrifying mass of tissue. A fungus present in the decomposing rhizomes was found to form spores in a similar manner to *Allantospora radiciola*, Wakker, a fungus which causes a root disease of sugar-cane in Java. It was not clearly shown, however, that the fungus found in the old rhizome was the cause of the disease (Howard, *Bull. Bot. Dept. Jamaica*, 1901, **8**, 181 ; 1902, **9**, 42).

A similar rot of the rhizome, caused by a species of *Pythium*, which occurs in India, was first recorded by Butler from Surat and is described by McRae in *Agric. Journ. India* (1911, **6**, 139). The disease spreads rapidly through the soil, and to prevent infection of healthy plants every portion of an affected plant must be removed and burnt, whilst the soil itself should be treated with lime, or a light dressing of sulphate of iron may be applied. Isolation of infested soil by a trench has been tried with success, but in the case of a bad attack, ginger should not be grown on the land for at least three years. The disease is most serious on wet, heavy soils, or in exceptionally rainy seasons, and it may be prevented to a large extent by draining the land, so that no water lies round the collar of the plant. Great care should be exercised in selecting only healthy rhizomes for planting purposes, any plants with even the slightest trace of disease being rejected. After a bad attack it is advisable to steep the rhizomes for

about half an hour in Bordeaux mixture before planting, to destroy any fungus spores or hyphæ on their surface or in the soil clinging to them. The fungus, which also occurs on tobacco and papaya in India, was at first thought to be *Pythium gracile*, Schenk, which in Europe is found on freshwater algæ. Subramaniam, however, showed that it is a distinct species, which he calls *Pythium Butleri* (*Mem. Dept. Agric., India, Bot. Ser.*, 1919, **10**, 181.

Another disease of ginger, which does some damage in Jamaica is locally called "cork rot." This cannot be detected until the crop is gathered, when the rhizomes are found to be of cork-like texture and quite valueless. The exact nature of this disease does not appear to have been investigated.

Uses of Ginger.

For flavouring purposes ginger is perhaps the most widely used of all spices. It is employed whole in the preparation of various confections, chutneys, pickles and the like, and in the ground condition for a great variety of purposes. Large quantities are used in the manufacture of ginger beer, ginger ale and similar beverages. Its medicinal value is well known, the root being used chiefly as a stomachic and internal stimulant, especially in flatulency and colic. The pungency of ginger is due to the presence of a resinous substance and the odour to an essential oil. The latter is separated by steam distillation and used to some extent in perfumery.

In connection with the attempts being made to improve the quality of Sierra Leone ginger, the Imperial Institute recently made enquiries regarding the uses of the various types of ginger, the results of which may be here summarised.

Unscraped (unpeeled) ginger is used as a cheap substitute for peeled ginger for most of the purposes for which the latter is usually employed. When peeled ginger is relatively cheap, less unscraped ginger is used in this way whilst, on the other hand, more of it is used when peeled ginger commands a high price. A certain amount of

unscraped ginger is also employed by distillers in the United Kingdom, who prefer it to peeled or scraped ginger, because it contains rather more essential oil.

For certain purposes only peeled ginger is suitable *e.g.*, for the "whole ginger" sold by grocers, for the best grades of ground ginger and for the best kinds of ginger beer. Unscraped ginger is sometimes used for the lower qualities of ground ginger, but not commonly for ginger beer. For medicinal use, "scraped" ginger alone is official in the British Pharmacopœia, but both peeled and unpeeled may be used for official preparations in the United States.

Ginger from no one country is in demand exclusively for any particular purpose. The peeled ginger from Jamaica, Cochin and Japan is all used for the same purposes, the grade of ginger employed depending on the quality of the article to be produced. Unscraped varieties from different sources are generally interchangeable.

TOBACCO CULTIVATION.

An address given by Professor J. S. Dash at a meeting of the Agricultural Society, held at the Imperial College of Tropical Agriculture on 20th January, 1927.

The Chairman introduced Professor J. S. Dash to the meeting. He referred to the great interest Professor Dash had taken in tobacco cultivation since his arrival here, and stated that no tobacco had hitherto been raised in this colony on a commercial scale or any part of the West Indies, with the exception of Jamaica. He was sure that the lecture would prove of great interest.

Professor Dash said: In the first place, I should like to say that our tobacco field work has been going on since 1923 primarily for the purpose of giving practical instruction to our students. From a beginning of about 100 plants we have progressed until this year we have an

area of $1^1/_2$ acres. One-half is devoted entirely to the study of strains and seed work, and the other half more particularly to finding out something of the commercial aspects of tobacco culture. Up to some time ago it looked very promising indeed and this prompted the suggestion that you might care to see it if you were interested. But unfortunately on Christmas Eve some persons entered the tobacco field and nearly an acre of the plants was pulled up. Next day the field resembled one in full harvest rather than one in full growth. Through the prompt action of the overseer they got a gang out on Christmas Day and replanted the tobacco. With the recent rains the plants had nearly all caught on again, but we stand to lose considerably with respect to leaves on the older plants. The younger ones suffered very materially from having their growth checked. They bloomed almost immediately and thus the leaf crop was relatively smaller. They would be able to see from certain plants left untouched in the scamper of the persons to get away, what the field would really have looked like. At the demonstration in the field I will be assisted by a post graduate student from South Africa, who has had a wide experience in tobacco growing.

It is not intended nor is it possible in a single effort to cover the subject of tobacco growing in all its various aspects and ramifications. It is a highly specialized industry, and one in which there is ample room for trained experts, for the crop is a peculiar one and not rivalled by any in regard to effect of soil, climate, fertilizers, handling, etc., on the final product. So much so indeed, that even those best qualified in its culture are at times baffled by its behaviour and varying response to the conditions under which it is grown. This is not hard to understand when it is remembered that the tobacco plant enjoys a very wide distribution, being cultivated on every continent of the globe :—Europe, Asia, America, Africa, Australasia, all figure in the production of various types and classes. It thus happens that what is termed quality in tobacco, as in many other products, while difficult to define, depends very largely on a point of view ; the quality required in cigarette tobacco, for example, being very different from

the quality required, say in a heavy pipe or plug tobacco. The grower, however, must keep certain generalized distinctions in mind since soil and treatment are most important factors, apart from variety considerations, in determining quality ; and in the long run, the grower is limited to the type he can profitably cultivate by the nature of his soil and environment. No other crop is so influenced by these factors as is tobacco, judged from the point of view of manufacturers' requirements, and high agricultural yields are, within limits, sacrificed in order to satisfy these requirements. Quality in the case of bright tobacco particularly, is usually enhanced where the crop is grown continuously on the same land.

It may be of interest to note that tobacco in the United States, the world's largest producing country, was at an early date subject to certain economic laws. Thus, in 1921, the profits were so great and the production of food crops neglected to such an extent that each colonist was limited in regard to the number of plants he could grow and even in the number of leaves allowed per plant. The expansion of the American industry since those early Virginian days has been phenomenal, for the crop is now grown in 12 States on nearly half a million farms and possesses a value of many millions of dollars.

British territories having relatively important tobacco industries are: India, Canada, Union of South Africa, Rhodesia, Nyasaland, Ceylon, and Australia. Considerable interest has developed in Nyasaland because of its suitability to the production of bright leaf probably closest in quality to that produced in the United States, which has hitherto enjoyed almost a complete monopoly in this particular class. Small but successful industries exist in other places, Jamiaca furnishing a good example. Under the existing protection it might be possible to supply some of the local demands, notably in the heavier manufacturing types. The Colony is importing annually about 500,000 lbs. of unmanufactured leaf.

With the decrease in cigar smoking generally and the special exigencies of the trade in this class of tobacco, new prospects for it are not promising.

The following is a brief outline of the more important points in the culture of the crop :—

Classes and Varieties.

There are two main classes of tobacco: the cigar and the manufacturing. The differences are commercial and varietal rather than botanical, both coming under the same species—*Nicotiana tabacum*. *N. Rustica* constitutes another class grown mainly for nicotine production and includes also Turkish and Levant tobaccos. The cigar group at the College is represented by the following varieties : Comstock Spanish, Big Havana and Connecticut Havana (all used as filler and binder) also four strains of Sumatra wrapper leaf. The manufacturing class may be divided into three groups of varieties : bright, heavy and special types. The first is represented in our collection by Hickory Pryor, Warne and Gold Leaf; the second by Kentucky One Sucker, Yellow Mammoth and Tennessee Red; the third by White Burley and Maryland. There are also in the plots two strains of *N. rustica* under observation for nicotine production. The first group demand special curing facilities in the way of flue-barns if a high quality bright leaf is to be obtained, and for special studies in this work it is hoped to be suitably equipped before long. Hickory Pryor is a promising variety in this connection. In the meantime, all varieties are being air-cured in the usual way.

Both Kentucky One Sucker and Yellow Mammoth are good yielders of heavy tobacco under our conditions. The greater part of the commercial area at the College is devoted to these two and an effort is being made to get accurate figures as to cost of production on this area.

Soils and Climate.

As noted previously, environment plays an important part in determining the type of tobacco to be grown. Broadly speaking, sandy or clay loams of high fertility are best suited to cigar tobacco, since the plants must make rapid and continuous growth, especially where high quality wrapper leaf is aimed at. In the case of bright tobacco, typical soils are light, infertile, sandy loams, liberal

applications of fertilizers being used to produce the crop. For dark, heavy-bodied tobacco the soils may be more clayey in texture than for the other classes and richer in organic nitrogen ; alluvial soils and the heavier loams are very suitable—in fact almost any good fertile soil gives satisfactory results. No matter what the type of soil unless it is well drained, profitable crops of tobacco cannot be produced.

The rainfall should be moderate but well distributed throughout the growing period and rather light during the maturing and harvesting period: heavy rains, especially at harvest time, are very prejudicial to the quality of the leaf which is rendered thin, deficient in gums and light in weight in proportion to bulk. Planting is therefore done in time to catch the late rains, allowing for sunny dry weather as maturity approaches.

Seeds and Seed Beds.

The tobacco plant being propagated from seed, the grower should take every precaution to select vigorous plants, true to type, and uniform in respect to time of maturity, as seed bearers. Where more than one variety is grown the seed heads should be bagged (any strong paper bags serves the purpose) before the flowers begin to open. The bags are retained in position until the seed capsules are full, it being necessary periodically to raise the bag as the flower stalk elongates, at the same time removing the old fallen flowers from the bags and destroying any bud-worms that may be at work. As soon as the seed pods turn brown they should be harvested and allowed to further dry out in a cool, dry room, free from vermin. The seed is then shelled, winnowed and placed in glass containers (*e.g.* jam bottles), taking care to reject that from poorly developed capsules which will be light and will tend to produce poor plants. Tobacco growers in many places are often inclined to favour the use of imported seed as against home grown, believing that the latter soon deteriorates. There is, it is true, every danger of this when seed selection is not practised.

The seed bed is the next care and the operations connected therewith must be regarded as an essential feature in tobacco cultivation. Failure at this point means crop failure. In the first place, a well-sheltered, well-drained spot with access to water supply must be chosen; the soil should be fertile and plentifully supplied with humus. The preliminary preparation consists in clearing and levelling followed by thorough working of the soil, with the incorporation of a liberal supply of well decayed compost or manure. The site is then lined off into beds of convenient size about 3 to 4 feet wide with paths between, which serve also as drains. Some method of sterilizing the beds to destroy weed seeds, ants, diseases pores, etc., is next recommended; for this purpose brushwood and other material should be piled on top of the beds and set on fire. The beds are afterwards brought to a fine tilth by careful mixing in of the ash resulting from the burnt bush, care being taken not to bring up unsterilized soil from below. The surface of the beds should be level in every respect; they are then ready for sowing and should be seeded at the rate of one teaspoonful of tobacco seed to 10 square yards: for even distribution the seed should be thoroughly mixed with some substance such as wood ashes before sowing. The surface of the beds after sowing is lightly pressed with a smoothing board before watering, which should be done from a can with fine rose. Sometimes a quick acting fertilizer is applied to the beds. The area of seed bed necessary can be judged from the fact that in one ounce of tobacco seed there are approximately 100,000 and an average teaspoon holds about 25,000 seeds when level. All the beds should not be sown at once; three or four sowings at intervals of about 14 days are suggested, depending on the area to be planted and to provide sufficient material for supplying losses from insects or other causes It is a common practice to provide some sort of covering for the nursery beds; under the humid conditions of this climate, where too much shading is given, the beds are subject to damping off troubles, and except for suitable shelter from wind and heavy rains, covering the beds is not absolutely necessary. The seeds germinate in from 7 to

10 days and the seedlings are ready for transplanting in from 6 to 8 weeks when they are 4 to 6 inches high; under-sized plants may be used only if weather conditions are favourable as they are liable to be killed out by hot sun. On the other hand, large plants may run to seed before normal growth has been attained. Beds to provide seedlings for transplanting during November and December, when the bulk of our planting is done, are sown from mid-September to the end of October. It is recommended that the site for seed beds be changed annually to avoid insect and fungus troubles. Where thorough sterilization can be effected the change need not be so frequent.

Preparation, Planting and Cultivation.

Land for tobacco should be first thoroughly ploughed and any green growth thoroughly incorporated; a second ploughing is given a little time after the first, in the opposite direction, when an application of well-rotted pen manure at the rate of about 10 tons per acre can be worked in; then at the time of planting the surface should be harrowed and brought to a fine tilth. Drains may be dug at this time. The practice next adopted at the College is to open shallow furrows 3 feet apart—the distance between the rows—into which a mixture of well-pulverized cattle droppings and wood ashes is applied at the rate of about 5 tons per acre. The soil is then thrown back on this and the plants inserted, a cloudy day being usually selected for the latter operation. Care must be taken in removing the transplants from the nursery beds which, if dry, should be thoroughly watered before any plants are removed. The distance between the plants in the row depends on the type of tobacco grown; under average conditions 2 feet is ample. After the plants have begun to grow two or more surface cultivations according to the nature of the soil should be given; cultivation should cease when the plants have reached such size as to render them liable to damage by implements and labourers, usually at the topping stage.

After Treatment.

When the plants are about a foot high they may be gone over and one or two small leaves at the bottom which

would be of little value removed. As soon as the plants have reached the flowering stage the operation known as "topping" is carried out and consists in the removal of the terminal bud to prevent seed development. At this time those plants selected for seed are marked and the flower heads allowed to develop. Topping should never be neglected if leaves of the required texture are to be obtained. The number of leaves left per plant will depend on the class of tobacco grown; generally speaking, the lighter sorts are topped high—12 to 16 leaves, and the heavier classes low, about 8 to 10 leaves. After the plants have been topped suckers will shortly appear in the axils of the leaves and these should be regularly removed. The leaves will now rapidly take on size and body until ready for harvest which is usually 4 to 6 weeks after topping.

Pests and Diseases.

The tobacco plant is subject to a number of troubles, but only a few of those commonly met with here need be referred to. The most important pest up to the present has been the mole cricket; it cuts off young transplants and losses may be as high as 50 per cent. of the stand, especially where tobacco is grown near grassy areas from which the crickets migrate. It has been noticed that fresh grass clippings placed underneath the young plants when put out in the field gives them a certain amount of protection. Where a plant is cut or injured it is advisable for a search to be made in the soil and the insect destroyed before another plant is inserted. Fields have to be frequently supplied where the mole cricket is prevalent. The horn-worm and the bud-worm make their appearance at an early time and the plants have to be regularly searched for the caterpillars which should be destroyed. This operation must be efficiently performed during the entire growing period in order to avoid serious losses from defoliation. The suppression of all waste vegetation near tobacco fields and seed beds will often aid in preventing liability to serious caterpillar outbreaks. Dusting or spraying is sometimes recommended against caterpillars where the area is large, but there is danger of leaf damage from the poisons used.

This is a problem for future investigation under local conditions. Grasshoppers may also be mentioned as capable of doing considerable damage where their numbers are large.

In the case of diseases, reference has already been made to "damping-off" in the seed beds; too much shading and humidity helps to spread the disease, likewise thick seeding; in some cases entire beds may be lost from this trouble. Liming is beneficial, but a change in site is advised, also proper sterilization of the soil as previously noted. So far, at the College, there have been no instances in the field of other well-known tobacco diseases such as root-rot, wilts, or mosaic. Some leaf spotting has appeared due to the recent excessive rainy conditions, coupled with the severe set-back which the maliciously pulled out plants received.

A careful watch is being kept for any new troubles which may appear with increase in area.

Harvesting.

The stage at which tobacco is harvested plays an important part in successful curing; it requires a little experience to judge when the crop is at the right stage for reaping. The leaves should neither be too ripe nor too green and the principal indication of ripeness is the decided change of colour. As maturity approaches there is a gradual change from a deep green to a greenish yellow and where the leaf is of heavy texture the yellow may only show in spots. The leaf itself at this stage instead of being soft and pliable becomes rough to the touch and brittle. In general, tobacco which is air-cured should not be allowed to get over-ripe.

There are two methods of harvesting tobacco: the whole plant and single leaf; each has its advantages. The former is the more economical but its disadvantage is that all the leaves are not in the same stage of ripeness. The single leaf system requires more labour; on the other hand, by this means it is possible to get all the leaves in the same stage of ripeness—an important factor in the production of highest quality tobacco. Nevertheless, the

whole-plant method is widely used in the case of manufacturing tobacco and has proved quite satisfactory at the College where the practice is adopted of splitting the central stalk of the plant with a sharp knife to within 6 inches of the bottom, the stems being next severed just above the ground. The splitting of the stalk assists in the drying out of the tissue. The plants are allowed to wilt for a short time and removed to the curing room where they are suspended over wires or laths, great care being taken to avoid bruising or breaking of the leaf.

Tobacco should be harvested in fine whether, but not while the dew is on it or immediately after rain. Prefert ably, reaping should not be done much before 3 o'clock in the afternoon, unless the plants are allowed to wilt under shade.

Curing, Stripping and Sorting.

Certain chemical changes take place during the curing for which processes the prime requisite is proper ventilation to ensure a good circulation of air. Over-crowding of the plants in the curing shed should be avoided; on the other hand, exposure to strong winds may do considerable damage to the leaf, while too much damp, moist air may cause harm by setting up attacks of mildew.

The size of shed will naturally depend on the area under the crop; generally speaking, about one square foot of floor space for every 3—4 plants, for each story or tier in shed. Any vacant out-building can often be converted into an improvised curing shed if precaution in respect to proper air circulation be taken. An inexpensive building with thatched roof will equally serve the purpose.

The plants are allowed to hang until the mid-ribs of the leaves are thoroughly dry before being taken down—usaully after 30 or 40 days. Curing completed, humid days have to be selected for the operations of stripping and sorting of the leaves, as on no account should tobacco be handled if the leaves are dry and brittle.

Sorting consists in classifying the leaves as fast as they are stripped into two or three grades depending on

requirements. In this operation, the bottom leaves are usually kept separate from the rest, while the latter may be further classified into "middles" and "tops." The tobacco is then pressed and packed in cases for delivery to the factory.

The process known as fermentation is beyond the scope of this paper.

Yields and Prospects.

Yields vary, depending on soil and treatment and the type of tobacco grown. Ordinarily, lower yields may be expected from varieties producing bright leaf than from heavy tobaccos. At the College last season from half-an-acre, of which a large part was in heavy tobacco, a yield of 700 lbs. was obtained and realised $504.00. In addition, there was a small ratoon crop of 200 lbs. which fetched much lower prices. This yield which works out at the rate of 1,400 lbs. per acre (exclusive of ratoon) may be considered good but certainly not excessive. On the average, it required 3 to 4 plants to produce 1 lb of cured tobacco; at 6 square feet to each plant, if the field stand had been complete, the yield on the area in question would have approximated 1,800 lbs. per acre. The losses were due almost entirely to mole cricket which is likely to be an outstanding cause of poor stands under local conditions. From these figures, it is considered quite possible for any grower to get 1,000 lbs. of cured leaf per acre which, at fair prices, will return a satisfactory profit.

Tobacco has not generally been a very successful crop where individual areas are large; the amount of supervision and handling necessary has usually restricted the area to be grown by any one individual—in the United States and Canada about 5 to 10 acres. The work, however, is not arduous even in the tropics, but time is an important factor. Preparation completed, keen gardeners in the early mornings and late afternoons will find pleasant occupation in the ordinary routine operations associated with the crop. Much can be done by mutual help in communities, notably at harvest time. In such ways, the actual amount paid

out for labour can be greatly reduced with substantial profits accruing to the grower.

It should be emphasized however, that any attempt at tobacco growing, to be in every way successful, must be seriously made, for the crop is a precarious one and left to its own resources is doomed to failure. Uniformity in quality and dependability of supply are commercial considerations of the highest importance and should be the constant aim of every tobacco grower if the well-being of industry is to be maintained.—*Proceedings of the Agricultural Society of Trinidad and Tobago, Vol. XXVII Part 1.*

GROUND NUTS.

We are greatly indebted to His Excellency the Governor for permission to publish the following correspondence dealing with Ground Nuts.—Editor.

COPY OF LETTER FROM MR. R. ROY WILSON, M.P., TO HIS EXCELLENCY THE GOVERNOR, DATED 28TH MARCH, 1927.

Dear Sir Cecil,

You will see from our Report that we are making a strong recommendation in regard to the growing of Ground Nuts in the Colony on a large scale for the purpose of export.

I thought you might like to see the analysis which I obtained from the well-known Liverpool firm of Oil Millers, Messrs. J. Bibby & Sons Ltd., and which is referred to in the chapter on Agriculture in our Report. I send you therefore a copy of Messrs. Bibby's letter to myself dated 9th February.

In my opinion, if the Sugar Planters would take up this proposal with enthusiasm it ought to result very advantageously to themselves, and I would hope that the sugar plantations in the various districts would, apart from their own cultivation, be great buying centres for the dis-

trict for Ground Nuts. That is to say, any small farmers in the districts who decide to grow Ground Nuts should be able, if the proper arrangements are made, to bring their nuts to the sugar plantations and obtain payment upon delivery.

If this business is properly organised it would, I am convinced, in time bring British Guiana into a prominent position among the other British Colonies who have developed so successfully the Ground Nut export trade.

Yours sincerely,
(Sgd.) R. Roy Wilson.

COPY.

J. BIBBY & SONS LTD.,
KING EDWARD STREET,
LIVERPOOL.
9th February, 1927.

R. Roy Wilson, Esq., M.P.

Dear Mr. Wilson,

Further to my previous letter and replying to your letter of the 2nd, I have had the samples of British Guiana Ground Nuts carefully analysed, and I am able to report as follows :—

No. 1, Sample from Sandy Loams of West Coast of Berbice. This is a sample of rather inferior nuts, showing a low yield of oil (33.27%) and a high percentage of Free Fatty Acid. This nut would compare with the West African Bissao quality which is about £1 per ton lower in value than the Rufisque quality and 15/- per ton lower than the Gambia quality.

No. 2, West Coast, Demerara, grown in soil rich in humus, and from a second reaping without replanting. This is a much better sample than the above, the oil yield is 36% which is about equal to the Gambia quality.

No. 3, from the East Coast of Demerara. This is a similar quality to No 2, and the same remarks apply.

No. 4, from the Enmore Estates, grown on sandy soil. This is a good quality Ground Nut which, if carefully picked, might be used for confectionery purpose, and would probably command a good price for this purpose.

Nos. 5 and 6. These samples are very similar, and although given as 2nd and 3rd quality are, in my opinion, of equal value. I should call them about equal to Gambia quality, or perhaps a little better.

On the whole these nuts compare favourably with the various West African varieties and would, I am sure, find a ready market both in this country and on the Continent.

In regards to your query *re* Gambia and Nigerian Nuts, you are no doubt aware that the former are usually shipped in the undecorticated state, and the latter as decorticated kernels, and on this account it is rather difficult to make a comparison.

Generally speaking undecorticated nuts produce a better oil than the decorticated kernels, but, of course, the yield of oil is much lower from the former, and a normal difference in price between one and the other is about £5 per ton in favour of the decorticated.

If Gambia Nuts were decorticated I think they would produce a rather better kernel than the Nigerian quality, but it is difficult to express any opinion when there is no experience to go upon.

Yours sincerely,

(Sgd.) W. B. Bibby.

ANNUAL REPORT

OF THE

BRITISH GUIANA SUGAR PLANTERS' EXPERIMENT STATION.

1st OCTOBER, 1925, to 30th SEPTEMBER, 1926.

COMMITTEE.

The permanent members of the Committee were the same as for the previous year, viz., Sir John Harrison, C.M.G., Chairman, Hon. R. E. Brassington, Messrs. G. E. Anderson, A. E. Craig, R. Strang, W. M. B. Shields and D. Clark. On the lamented death of the Chairman in February, Mr. R. Strang was appointed Chairman and remained in this capacity until May when he went on leave. Mr. G. E. Anderson, succeeded to the Chairmanship which he has held to date. Mr. W. S. Jones continued to act for the Hon. R. E. Brassington until the latter's return to the Colony in March, while Mr. A. C. Ashbee acted for Mr. A. E. Craig from March until September. Messrs. C. Farrar and A. Murison acted for Messrs. W. M. B. Shields and R. Strang respectively from May until September.

STAFF.

SUPERINTENDENT.

This officer was absent on leave from 19th March to 16th April, 1926.

CHEMIST.

Mr. Lauchlan was absent on leave from December, 10th, 1925, to January 17th, 1926.

SECRETARY.

Mr. C. L. C. Bourne has held this appointment.

FIELD MAMAGER.

Mr. J. E. Kidman held this appointment on probation till May 30th, when Mr. C. Cameron was promoted. Mr. Cameron is an enthusiastic worker and has already shown that he will prove an efficient field manager.

FIELD OVERSEER.

Mr. Cameron held this appointment until his promotion on June 1st. Mr. H. D. Huggins, Diplomate of the Imperial College of Tropical Agriculture, Trinidad was appointed on probation on July 15th, the title of the post being changed to that of "Assistant Field Manager."

LABORATORY ASSISTANT.

Mr. E. S. A. Chin, who was absent on sick leave for a short period, remains in this post.

CLERICAL ASSISTANT.

Miss. M. Sealy continues in this appointment.

OBITUARY.

With the death of Sir John Burchmore Harrison, the Station has lost not only a Chairman but the advice of one who had carried on the raising of cane seedlings continuously since the discovery that sugar cane arrows produced fertile seed. Together with Jenman and Ward he was responsible for the production of D. 625 and D. 145, which have proved to be of such value to the Sugar Industry of his Colony.

WEATHER.

The long drought which only broke in June has proved a disaster to the Station as well as to the Sugar Industry of this Colony. Canes which should have been reaped in October 1925, immediately after analysis, were not cut till June 1926, owing to there being insufficient water in the navigation trenches for transportation. To a certain extent this will invaliditate the results of the year's work, but not completely, as the control rows of most of the fields were reaped with the remainder of the crop in June—September 1926.

From the diagrams under "DRAINAGE," it will be seen that the 8 inch centrifigul pump driven by the 8 H.P. Mietz and Weiss engine is now capable of dealing with ordinary rainfall, but cannot cope with exceptionally heavy or long continued rain. The capacity is about 1¼ inches rainfall in 24 hours, the area drained being 115 acres.

It is regretted that the Experimental Fields are still dependent on gravity drainage. It is hoped that a pump will be installed in the near future.

MANURIAL PLOTS.

It will be seen from the accompanying table that the crop was greatly reduced as a result of the drought and that the differences though still small are comfirmatory of results reported previously. It would appear that the waterlogged condition of this field during the previous year, which produced a very shallow root system, is largely responsible for the extremely poor growth. The canes were over mature when cut, it is true, but at no time was the growth vigorous.

It will be necessary to replant these fields in the near future, and it is proposed to put this in hand when the drainage conditions have been rectified.

SERIES. I.

Manurial Treatment	Tons Cane per Acre. Not Mulched	Mulched with rice straw.
Unmanured	8.7	14.1
Minerials only (no nitrogen) ...	9.4	14.8
Minerals + 200 lbs. Sulphate of ammonia	13.8	18.5
Minerals + 300 lbs. "	13.9	16.6
Minerals + 400 lbs. "	14.3	16.9
Minerals + 500 lbs. "	13.6	14.5
Minerals + 375 lbs. Nitrate of soda...	8.8	13.9

SERIES II.

MANURIAL TREATMENT	TONS CANE PER ACRE.
Nitrogen only	11.1
Nitrogen + Superphosphate ...	13.2
Nitrogen + Potash	13.1
Nitrogen + Potash + Superphosphate ...	14.6

1925 SEEDLINGS

A comparatively small number of seedlings was raised. Arrows were only collected from those varieties which had been examined in the laboratory and had shown promise, or which had appeared to be of special merit from their field characters. As the laboratory examination was started a month or so before arrows began to appear, only a few parents were selected in time for the collection of arrows.

1523 seedlings were ultimately planted in baskets and of these 735 were planted out in the field. The germination was low, probably as a result of the dry conditions.

Details as to the parentage of these seedlings will be found in the following table :—

Parents' Performances at Station.

Stock	Grand-parent	Parent	Tons Canes	% Avail.	Tons Sugar	Seedlings Basketed	Seedlings Planted out in field
Bourbon	Bourbon	416/21	14.5±3.2	3.7±1.0	1.27±.36	17	12
	D64	16/22	27.3	11.90	3.25	12	4
	D281	1813/21	17.6±1.9	10.07±.31	1.74,,.13	18	13
	D625	261/21	13.1	10.24	1.34	20	4
	,,	619/21	34.4±3.9	10.19±.19	3.59,,.11	27	2
Red Ribbon	D145	651/21	24.9	11.47	2.86	203	132
	,,	124A/21	24.9	10 27	2.56	387	222
	,,	112/21	16.8	10.66	1.99	229	162
	,,	98A/21	18.6	10.20	1.90	29	12
	,,	73/21	23.2	10.26	2.38	35	30
	,,	162/17	24.7 ±2.75	11.66±.43	2.92,, 38	52	22
	,,	657/21	18.0	8.61	1.55	15	6
	,,	89/21	17.2	10.73	1.85	62	12
	,,	195/21	13.1	10.50	1.38	121	24
Bourbon × Red Ribbon	D625 × D145	1641/22	28.8±8	9.79±.09	2.36,,.09	32	24
	.	D625×R R	16.3±1.26	10.54±.26	1.71,,.12	69	7
Green Transp.	Gr. Tr.	187/21	30.0	10.31	3.09	15	8
	,,	201/21	14.5	12.11	1.75	29	3
	,,	190/21	19.2	10.55	2.03	18	5
White Transp.	D755	1400/22	23.0	10.13	2.10	13	4
	D5	733/18	26.4±1.1	10.73±.18	2.88,,.13	6	1
Wh. Tr. × Bourbon	...	D625	28.8±.8	9.79±.09	2.36,,.09	68	13
		× Wh. Tr.	14.8±2.8	10.66±.35	1.61,,.33		
Purple Transp. × Bourbon	...	D625	28.8±.8	9.79±.09	2.36,,.09		
		× Purple Transp.	...	...	...	8	1

1924 SEEDLINGS.

A careful selection of these was made and 29 were extended at Sophia.

Parent.	*Number of seedlings extended.*
B.H.10 (12)	12
D145	11
D419	4
D118	1
Green Transparent.	1

UBA X D145.

The seedlings produced by this cross were transferred to the Experimental Fields by Mr. Bastiaans in 1924, under instructions given by the late Sir John Harrison.

Unfortunately it has been discovered that sufficient care had not been taken to keep the individual seedlings separate, for as great a variation was found between one stool and another in any one row as was found between different rows. As extensions from rows would not be satisfactory, since this would give obviously mixed strains, each individual stool was treated as a unit, and extended at Sophia. This may result in a few strains appearing under more than one seedling number, but there is no doubt that each seedling number refers to one strain only.

UBA, ZAWENGA AND BAMBOO.

The plots of these varieties were cut and weighed, and the following results were obtained :—

Zawenga	...	29.5 tons cane per acre
Bamboo	...	24.9 „ „ „ „
Uba	...	24.3 „ „ „ „

It would appear the Zawenga is the best of the three, and it has been extended as a precautionary measure, since these varieties have the reputation of being immune to Mosaic Disease.

HYBRIDISATION PLOTS.

A selection of 16 seedlings with exceptionally high sucrose content and 9 seedlings of exceptional vegetative growth have been planted, in a chessboard, single stock forming the unit. It is thought that this arrangement will be more convenient for carrying out crossing operations than the older one of alternation of rows. At the same time a very much smaller area and far less planting material is required.

The results given by these seedlings at Sophia as 1st Ratoons will be found in the following table :—

Selected for Cane Tonnage.

Stock	Parent	Seedling No.	% Avail.	Purity of Juice	Tons cane per acre	Tons Sugar per acre
Bourbon	D625	572/17	8.81 ± .50	78.9 ± 1.93	12.7 ± 10.4	3.80 ± 1.13
	„	231/20	9.21 „ .22	81.7 „ .62	41.3 „ 4.8	3.80 „ .42
	„	351/20	10.80 „ .57	86.8 „ .38	40.5 „ 1.8	4.39 „ .20
	„	349/20	9.97 „ .14	84.5 „ .51	40.2 „ 2.9	4.02 „ .34
	„	601/21	7.15 „ .25	75.3 „ .99	38.7 „ 7.0	2.75 „ .40
Red Ribbon	D145	203/20	9.87 „ .24	82.1 „ .85	39.2 „ 4.3	3.94 „ .38
	„	169/17	10.58 „ .38	85.0 „ .71	29.8 „ 2.7	3.17 „ .31
Green Tr'nsp.	Green Tr'nsp.	895/21	9.23 „ 1.14	87.5 „ 1.9	40.4 „ 1.1	3.74 „ .56
	„	661/18	8.17 „ .09	77.1 „ .15	37.3 „ .27	3.07 „ .03

Selected for Sugar Content.

Stock	Parent	Seedling No.	Sugar % Avail.	Purity of Juice	Tons cane per acre	Tons sugar per acre
Bourbon	D248	554/18	11.39 ±.126	87.7 ± .41	28.3 ±1.07	3.2 ±.145
	D625	246/20	11.58 ,, .184	86.8 ,, .55	19.4 ,, .81	2.24 ,, .093
	,,	585/20	11.51 ,, .34	86.8 ,, .81	17.0 ,, 3.7	1.96 ,, .42
	,,	345/20	10.95 ,, .25	87.0 ,, .54	13.9 ,, 1.99	1.53 ,, .19
	,,	628/20	10.94 ,, .11	85.6 ,, .3	19.7 ,, .95	2.16 ,, .11
	,,	,,	10.71 ,, .14	85.6 ,, .7	13.8 ,, 1.5	1.48 ,, .16
	D721	447/17	11.32 ,, .23	86.9 ,, .13	33.8 ,, 1.8	3.80 ,, .22
Red Ribbon	D145	162/17	11.66 ,, .43	86.9 ,, 3.03	24.7 ,, 2.75	2.92 ,, .38
	,,	679/20	11.56 ,, .15	89.1 ,, .37	17.8 ,, 3.95	2.08 ,, .49
	,,	729/20	11.44 ,, .78	89.2 ,, 1.25	25.2 ,, .29	2.88 ,, .17
	,,	699/20	11.43 ,, .57	83.6 ,, 2.01	19.2 ,, 2.4	2.15 ,, .32
	,,	366/20	11.36 ,, .22	92.1 ,, .90	18.6 ,, 1.2	2.11 ,, .10
	,,	156/20	11.25 ,, .11	88.0 ,, .25	14.4 ,, 2.06	1.63 ,, .25
	,,	1005/20	11.22 ,, .19	89.4 ,, 1.60	16.6 ,, 2.10	1.89 ,, .32
	,,	369/20	11.18 ,, .43	87.8 ,, .18	12.3 ,, 1.49	1.36 ,, .16
	,,	169/17	10.58 ,, .38	85.0 ,, .71	29.8 ,, 2.70	3.17 ,, .31
	D145 x POJ 139	813/18	10.94 ,, .36	85.3 ,, 1.62	16.9 ,, 2.22	1.87 ,, .26
White Tr'nsp.	D239	528/18	11.22 ,, .95	85.6 ,, .52	23.9 ,, 3.69	2.40 ,, .37
	Not known	856/20	11.56 ,, .35	89.0 ,, 1.69	21.1 ,, 2.15	2.43 ,, .21

It is hoped that a cross of a member of the first group by a member of the second may give a hybrid which combines a heavy cropping capacity with a high sugar producing power.

Stumps were utilised as planting material and the growth obtained is highly satisfactory. Square planting has been adopted, the distance between two stools being 2 feet. This close planting will enable arrows from neighbouring stools to be brought together in one bag with

little difficulty. The method of de-antherising the arrows by spraying with water from a "Flit" sprayer, as recommended by d'Albuquerque will be adopted.

GREEN MANURES.

Sesbanea aculeata.

The high hopes entertained as to the future value of this plant in the Colony and expressed in the last Annual Report have not been realised. A caterpillar, *Mocis repanda*, the Grass Looper, which makes its appearance with unfailing regularity every year in June or July prefers Sesbanea to any other food. Plants 1 to 2 feet high were eaten down to the ground, both leaves and stems being consumed in less than a week. As it would not be an economic proposition to treat a green manure crop with insecticides, it is probable that some other plant will prove more suitable. At the same time it must be remembered that the tilth of the soil was not good and that the ground was by no means free from weeds. With a good clean friable seed-bed better results might have been obtained.

Crotolaria striata

This plant made extraordinarily good growth, even during the drought, the greatest height attained being 12 feet. The average was 7 feet, and it completely overshadowed all the shorter varieties of banana among which it was growing and rivalled the taller ones. Its growth was not appreciably effected by the dry weather, no signs of wilting being seen at any time. A further and even more important character is that this plant is immune to the depredations of the Grass Looper. This was rather strikingly demonstrated when the Grass Looper attack was most severe in June. A rambling vine known as the Wild Potato (*Ipomoea sp.*) growing on the edge of the drain had climbed in and amongst the *Crotolaria* right to the centre of the bed. This vine was completely devoured by the Grass Loopers but not a single leaf of the *Crotolaria striata* was touched.

There is, however, one difficulty with this plant; it is subject to the depredations of a seed-destroying insect; so that it is not easy to produce large quantities of seed. It is of interest to note that this insect is preyed upon by the same parasite as that which preys upon the Cane Moth Borer. It is possible that large areas of *Crotolaria striata* might have an appreciable influence on the degree of parasitisation of the Moth Borer.

Vigna repens

The growth made by this legume is also quite satisfactory, and it is being extended as rapidly as possible. It has been found that by planting 3 to 4 seeds in small holes made be a cutlass at a spacing of 3 feet 6 inches x 2 feet 6 inches, a sufficiently dense mat is obtained as to suppress all other vegetation. The second crop is, as a rule, better than the first, owing no doubt to the wider distribution of the symbiotic organism in the soil. As would be expected, vegetative growth is most vigorous during the rainy season. The crop stood up moderately well at first to the unfavourable conditions during the drought, but finally succumbed.

It seeds freely, and does not appear to suffer greatly from insect attack.

SOPHIA.

THE EXAMINATION OF THE SEEDLINGS.

As indicated in the last Annual Report, a systematic examination of the seedlings in cultivation at Sophia was commenced on September 15th, 1925. The East Section was completed on December 18th., the number of samples analysed being 5,686. The examination of the West Section was commenced after the Christmas holidays on January 12th, and, with the exception of the young transplants, finished on March 12th., 1926; 4,288 samples having been examined.

The transplants of the 1922 and 1923 seedlings together with the spacing experiment plots and a few from the Experimental Fields were examined in August 1926;

545 analyses being carried out. The total number of samples examined during the season, which, as pointed out in the last reports includes 690 from the previous financial year, was 10,519.

The number of samples must be high if any attempt is to be made to determine the degree of reliability of the results.

The labour of calculating the results of the analyses was reduced by a Marchant calculating machine which was kindly lent to the Station by Messrs. Booker Bros. McConnell & Co., Ltd. Unfortunately, after the work had been finished it was discovered that an error had been introduced through the use of an incorrect table so that all the results had to be recalculated.

A Marchant calculating machine was imported from America and arrived in July 1926. With the aid of this machine a statistical examination has been made of all varieties of which three or more samples have been analysed.

The following determinations have been made :—

The Arithmetic Mean The Standard Deviation The Standard Error of the Mean The Coefficient of Variability The Standard Error of the Coefficient of Variability	of	Cane tonnage per acre. Per cent Available Sugar. Tons sugar per acre. Coefficient of Purity, (Coefficient of Variability not determined)

This has proved a long and tedious task, which was only completed in January 1927, and is responsible for the delay in the preparation of this report.

Before proceeding to discuss the results obtained, it may be of interest to describe the method adopted for weighing the crop. The unit adopted is the row. From each row a representative sample of 6 canes was taken for analysis. It is now realized that this was too small a sample and is subjected to a very large sampling error. It would have been better if one or two complete stools had been cut and taken for analysis.

At reaping, the canes are laid on the row. A substantial spring balance (weighing to 100 lbs) carrying a small cradle and suspended from a bamboo tripod is used on each bed. The canes are weighed row by row, the individual weighments being written down by an assistant who supervises the work of three balances. The record is taken in carbon paper duplicating books, one for each bed, and at the end of the day's work the loose sheets are handed in to the office where the necessary additions are made. The width of the bed is also noted on each sheet, and with the aid of the calculating machine the crop is calculated in terms of tons of cane per acre. This multiplied by the sugar content, gives the tons of sugar available per acre. Where there are several rows of a variety, the means are calculated, so enabling a selection to be made for the immediate extension of promising seedlings. The selected varieties are marked with flags in the field, and, after a careful examination, all the available planting material is collected, bundled and labelled, and transported to the field where planting is in progress. The remainder of the crop is loaded into punts and despatched to the factory at Pln. Ogle for grinding. The extended rows of each variety are staked and labelled and a record is also made in a note book provided for the purpose, so that the identity of each seedling is never in doubt. The reaping of the crop was commenced in June 1926 and completed during August. The yield was extremely low owing to the high percentage of dead and dried canes as a result of the drought, reaping being 9 months late. The juice was extraordinarily poor, more especially in those fields which had been subjected to water logging in the early stages of the growth of the cane. So far as the cane tonnage figures are concerned, we can feel confident that any variety which has done well is a really vigorous variety.

It is obviously impossible to report the results in detail here. It is hoped to publish a full account in the form of a Bulletin in the near future. They are summarised in the following tables, in the study of which it

must be remembered that all the determinations are not of equal significance, since many seedlings are only represented by a single row. The guiding principle which has been adopted in making selections for extension is that any seedling which has given either a heavier cane tonnage or a higher sugar content should be extended and tested again. This rather generous selection has been considered advisable on account of the exceptional weather conditions which have prevailed.

Classification according to the tons of cane per acre.

Class		Nos. of varieties in each class produced in					
Limits tons cane per acre	Mean tons cane per acre	1917 & earlier.	1918	1920	1921	1922	Total
0.0— 1.2	0.6	...	...	...	...	3	3
1.3— 3.7	2.5	...	...	4	2	35	41
3.8— 6.2	5	...	...	13	18	101	132
6.3— 8.7	7.5	3	4	29	43	169	248
8.8—11.2	10	3	6	48	86	164	307
11.3—13.7	12.5	2	4	62	117	201	386
13.8—16.2	15	5	5	60	146	213	429
16.3 18.7	17.5	1	5	65	144	184	399
18.8 -21.2	20	5	8	43	149	168	373
21.3—23.7	22.5	6	7	31	149	114	307
23.8—26.2	25	5	6	31	141	92	275
26.3—28.7	27.5	7	6	29	94	87	223
							(D625)
28.8—31.2	30	6	4	11	71	47	139
31.3—33.7	32.5	6	1	7	51	36	101
33.8—36.2	35	1	...	4	41	26	72
26.3—38.7	37.5	1	1	2	24	15	43
38.8—41.2	40	1	...	...	11	8	20
41.3—43.7	42.5	1	...	...	5	12	18
43.8—46.2	45	...	...	...	2	4	6
46.3—48.7	47.5	...	...	1	5	3	9
48.8—51.2	50	...	...	...	1	...	1
51.3—53.7	52.5	...	...	...	2	1	3
53.8—56.2	55	...	...	...	...	2	2
56.3—58.7	57.5	...	...	1	1	1	3

Classification according to % Available Sugar.

Class: Limits available sugar per cent.	Class: Mean Sugar per cent.	Seedlings of: 1917 & earlier	Seedlings of: 1918	Seedlings of: 1920	Seedlings of: 1921	Seedlings of: 1922	Seedlings of: Total
4.88—5.17	5	—	—	—	6	3	9
5.13—5.37	5.25	—	—	—	6	4	10
5.38—5.62	5.5	—	—	—	6	4	10
5.63—5.87	5.75	—	—	—	15	13	28
5.88—6.12	6	—	—	2	18	7	27
6.13—6.37	6.25	—	—	1	27	14	42
6.38—6.62	6.5	—	—	5	39	17	61
6.63—6.87	6.75	—	—	9	59	22	90
6.88—7.12	7	—	3	5	60	37	105
7.13—7.37	7.25	—	2	6	70	34	112
7.38—7.62	7.5	—	2	14	82	56	154
7.63—7.87	7.75	1	4	18	98	66	187
7.88—8.12	8	2	3	19	95	75	194
8.13—8.37	8.25	3	4	26	112	97	242
8.38—8.62	8.5	4	6	31	110	98	249
8.63—8.87	8.75	6	5	42	87	115	255
8.88—9.12	9	4	5	37	86	94	226
9.13—9.37	9.25	4	4	41	73	99	221
9.38—9.62	9.5	7	3	34	62	111	217
9.63—9.87	9.75	6	3	38	63	128	238
9.88—10.12	10	2	—	33	53	108	196
10.13—10.37	10.25	4	4	28	33	111	180
10.38—10.62	10.5	6	1	21	13	86	127
10.63—10.87	10.75	2	3	16	6	72	99
10.88—11.12	11	1	—	3	3	59	66
11.13—11.37	11.25	—	2	5	4	44	55
11.38—11.62	11.5	—	—	1	3	34	38
11.63—11.87	11.75	1	—	—	—	37	38
11.88—12.12	12	—	—	2	2	21	25
12.13—12.37	12.25	—	—	1	—	14	14
12.38—12.62	12.5	—	—	1	--	13	14
12.63—12.87	12.75	—	—	—	—	2	2
12.88—13.12	13	—	—	—	—	2	2
13.13—13.37	13.25	—	—	—	—	1	1
13.38—13.62	13.5	—	—	—	—	1	1
13.63—13.87	13.75	—	—	—	—	1	1
13.88—14.12	14	—	—	—	—		—

D625

Classification according to Tons Sugar per acre.

Class		No. of varieties in each class produced in					
Limits tons sugar per acre	Mean tons sugar per acre	1917 & earlier	1918	1920	1921	1922	Total
0—0.12	.07	...	...	...	...	7	7
0.13—0.37	.25	...	...	6	8	66	80
0.38—0.62	.5	3	2	23	40	133	201
0.63—0.87	.75	1	3	46	91	177	318
0.88—1.12	1.	4	8	56	137	198	403
1.13—1.37	1.25	1	4	54	174	194	427
1.38—1.62	1.5	5	7	64	165	178	419
1.63—1.87	1.75	1	6	50	156	165	378
1.88—2.12	2.	5	9	41	148	141	344
2.13—2.37	2.25	4	4	26	118	105	257
2.38—2.62	2.5	6	5	27	101	98	237
2.63—2.87	2.75	9	3	21	56	64	153
2.88—3.12	3.	6	5	10	35	50	106
3.13—3.37	3.25	...	...	3	19	27	49
3.38—3.62	3.5	4	...	3	15	24	46
3.63—3.87	3.75	3	...	1	14	12	30
3.88—4.12	4.	...	...	...	3	10	13
4.13—4.37	4.25	...	...	...	1	7	8
4.38—4.62	4.5	...	...	...	2	8	10
4.63—4.87	4.75	...	...	...	...	4	4
4.88—5.12	5.	...	...	2	1	2	5
5.13—5.37	5.25	...	...	...	...	1	1
5.38—5.62	5.5	...	...	...	...	1	1
5.63—5.87	5.75	...	...	...	...	3	3

D625

Of those varieties of which 3 or more rows have been examined, 22 have been selected for distribution to the estates. In these sugar yield is significantly higher than that given by D625, the difference being greater than three times the standard error of the difference. The performance of these varieties as 1st. Ratoons is given in the following table :—

Preliminary Statement of Promising Seedlings Selected for Distribution.

Seedling	Tons Sugar per acre	% Avail. Sugar	Rows	Tons Canes
351/20	4.39 ± .20	10.8 ± .57	57	40 ± 2
439/20	4.02 „ .34	9.97 „ .14	146	40 „ 3
203/20	3.94 „ .48	8.87 „ .24	170	39 „ 4½
231/20	3.80 „ .42	9.21 „ .22	11	41 „ 5
337/20	3.58 „ .22	10.31 „ .17	27	34½ „ 2
7/20	3.44 „ .09	10.85 „ .10	7	32 „ 1½
71/20	3.38 „ .23	9.66 „ .56	7	35 „ ½
209/20	3.04 „ .16	10.61 „ .23	13	29 „ 1½
554/18	3.22 „ .14	11.39 „ .13	49	28 „ 1
507/18	3.17 „ .17	10.30 „ .18	22	30 „ 1½
403/18	3.15 „ .12	9.85 „ .12	54	32 „ 1
666/18	3.07 „ .03	8.18 „ .09	274	37 „ ½
106/17	3.80 „ .13	11.66 „ .11	29	35¾ „ 1½
447/17	3.80 „ .22	11.32 „ .23	24	33½ „ 2
81/17	3.56 „ .20	10.14 „ .25	35	35 „ 2
31/17	3.44 „ .34	9.56 „ .40	36	36 „ 3
576/17	3.40 „ .26	9.61 „ .24	39	35 „ 2
238/17	3.39 „ .15	10.50 „ .17	98	32 „ 1½
15/17	3.14 „ .22	10.08 „ .17	125	31 „ 2
84/17	3.11 „ .16	9.79 „ .17	103	31½ „ 1½
195/17	3.03 „ .16	10.08 „ .19	61	29 „ 1½
73/17	2.91 „ .12	8.29 „ .12	85	36 „ 1
D,625	2.36 „ .09	9.79 „ .09	(112) (obs)	29 „ ¾

OLD VARIETIES.

These were also examined, and the results obtained are given below.

Variety	Tons Cane per acre	% Avail Sugar	Tons Sugar per acre
Red Ribbon	11.5 ± 1.58	10.99 ± .442	1.31 ± .210
Bourbon	13.2 ,, 1.12	10.52 ,, .210	1.39 ,, .125
Caiara	28.0 ,, 1.82	9.38 ,, .286	2.61 ,, .166
Leonardina	16.2 ,, 1.65	10.66 ,, .966	1.73 ,, .187
Maroni I.	16.3 ,, 5.26	10.66 ,, .784	1.78 ,, .439
White Transp.	14.8 ,, 2.76	10.66 ,, .347	1.61 ,, .333
Sao Caetano	24.1 ,, 6.75	10.63 ,, .846	2.58 ,, .416
Samsara	17.8 ,, 1.93	9.37 ,, .382	1.66 ,, .196
Z. Cheribon	10.3 ,, 7.85	10.62 ,, .594	1.19 ,, .952
B 208	23.0 ,, 1.99	10.57 ,, .268	2.44 ,, .223
Sacuri	18.6 ,, 5.51	9.76 ,, 1.078	1.87 ,, .740
Canna Preta	21.3 ,, 5.04	8.93 ,, .696	1.94 ,, .550
Burke	18.0 ,, 3.29	11.10 ,, .641	1.98 ,, .455
Mantiego	26.2 ,, 7.32	9.45 ,, .561	2.54 ,, .800
73 Jamaica	14.5 ,, 6.18	9.87 ,, .573	1.45 ,, .662
B. 147	19.5 ,, 1.14	6.74 ,, .924	1.33 ,, .262
Uba	28.9 ,, 2.89	7.80 ,, .282	2.25 ,, .283
Armstrong	17.5 ,, 6.66	9.03 ,, .636	1.58 ,, .294

The total number of varieties extended, either for distribution or for further trial is given in a table on the next page. It will be seen that a very considerable reduction has been effected, but that the number is still very high. Owing to the high pressure at which the selections were made, a number of promising seedlings, worthy of future trial, were overlooked. These will be examined in the field as 2nd Ratoons, and a further extension made.

In future it may possibly be better to make extensions from the young spring about six months after reaping, rather than to attempt to work up the data in time to make selections for planting the tops of the reaped canes. Better

Number of Seedlings Extended.

Year Produced	No of Varieties examined (based on tons sugar per acre values)	No. of Varieties extended.
1917 & earlier	52	37
1918	56	21
1920	433	144
1921	1,284	396
1922	1,675	570
Total	3,500	1,168 or 33¼ per cent

No. of varieties giving better returns than D625 as regards

Year Produced.	Cane Tonnage.	Available Sugar.	Sugar per acre.
1917 or earlier	16	16	28
1918	6	10	13
1920	26	110	67
1921	214	117	247
1922	155	606	311
Total	417 or 11.9 per cent.	859 or 24 5 per cent	666 or 19.0 per cent.

planting material would be obtained, and the selection would be made after the statistical examination was complete. This postpones planting for six to eight months, but the attendant advantages more than compensate for the delay.

DRAINAGE.

Pumping Plant.

A thorough examination of the Mietz and Weiss 8 H.P. oil engine, which forms the power unit of the pumping plant, was made in the early part of the period under review.

It was found that the plant could be reconditioned so as to give moderately satisfactory service. This has been done.

The Side Line Canal.

The pumping plant was operated until the side-line was practically empty. It was found necessary to deepen the channel connecting the basin and the side-line, as well as the collecting basin itself, by a considerable amount before the side-line was dry. As might be anticipated, it was found that the side-line was deplorably shallow, being at least 2 feet above the level of the koker sill. On taking levels it was brought to light that the canal was not graded, but that it would be possible to obtain a fall of about 2 feet per mile by excavating. A distinct crest in line with fields 10 and 11 was responsible for the very poor flow from the southern end of the Station. The West Side Line was then deepened and correctly graded, so that there was a uniform fall from south to north. Only 1 foot was taken from the East Side Line, and that only in the area under cultivation. A number of cuts connecting the two side lines were deepened.

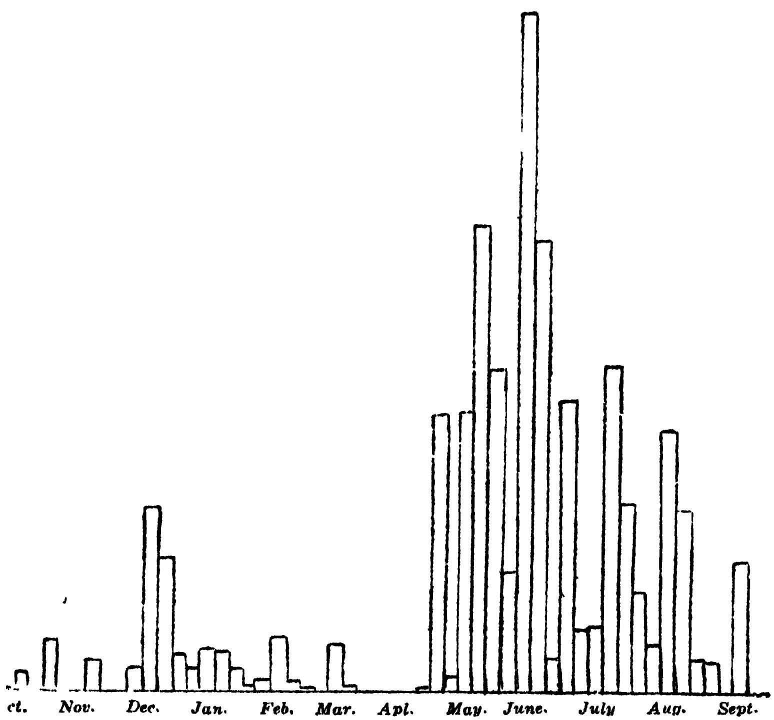
The Collecting Basin.

As has already been implied this was too small and was connected with the side-line by an inadequately small

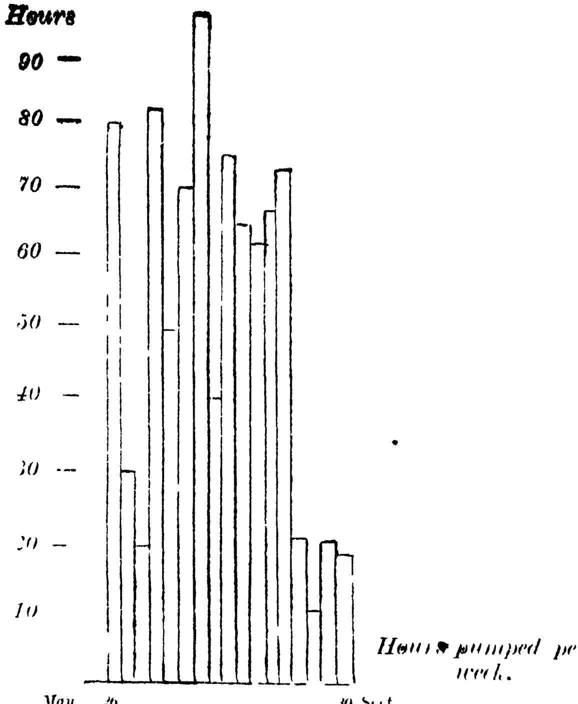
ditch. The basin was extended towards the South to a point well beyond the koker connection the Side Line with the Cumings Canal and a broad connection thus made with the Side Line,

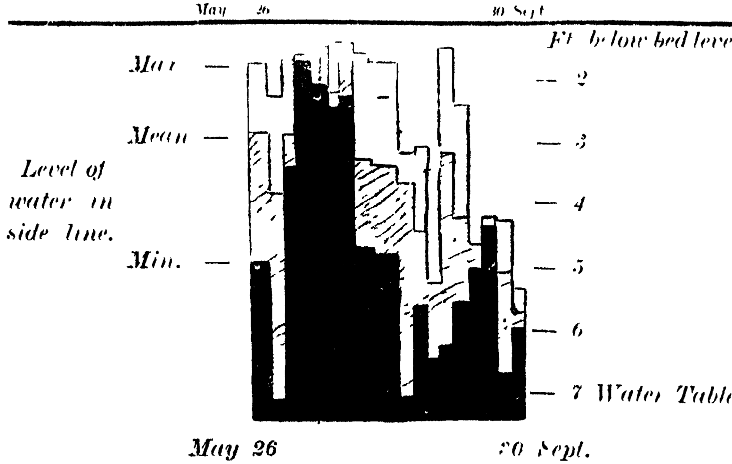
As it was desirable that it should be possible to transfer the pumping plant from the basin to the navigation trench for irrigation purposes when necessary, two locks were installed, one between the navigation trench and the basin, and one cutting off the pumping basin from the collecting basin proper. These were constructed of Greenheart.

RAINFALL & WATER LEVEL.



RAINFALL.





There is no doubt that the new arrangement has effected a great improvement, but the capacity of the pump is insufficient to cope with heavy rainfall. It is not unusual to experience a rainfall of 10 or 12 inches in 5 or 6 days, *i.e.*, with an average of 2 inches in 24 hours, If the pump is only capable of removing 1½ inches in

24 hours, it is inevitable that the fields should be flooded. Unfortunately, it has always been at times of heavy rainfall that the engine has broken down from some cause or other, and one can only summarise the position by saying that the drainage of the Station has been a continuous source of anxiety during the last two years.

UNDER-DRAINED PLOTS IN FIELD 12 W.

These, with the two neighbouring control beds, have been planted with seedlings and controls. It is proposed to weigh the produce of these, row by row, both as a test of these promising seedlings and also as a comparison of under-drainage with ordinary drainage. On forking these plots the labourers found that the soil on the under-drained areas was much easier to work than on the control beds.

UNDER-DRAINED PLOTS ON THE ESTATES.

It has been ascertained that the plots on various estates which have been drained experimentally by the cut-and-cover method have not suffered from waterlogging, and that the cane has appeared to be healthier than on the neighbouring control plots. Unfortunately, no crop returns are available so far, but it is hoped that these will be obtained in the near future.

SPACING EXPERIMENT.

The results obtained in this experiment are largely vitiated by the drought. The figures are given in the following table, but it is very doubtful whether any significant conclusions can be drawn :—

No. of tops per row.	Tons cane per acre	% Avail Sugar.	Tons Sugar per acre.	Coefficient of Purity.
6	7.14 ± .66	5.30 ± .19	0.39 ± .04	74.4 ± .86
9	9.9 „ .41	4.97 „ .23	0.45 „ .04	73.0 „ 1.00
12	10.8 „ .58	5.26 „ .28	0.59 „ .06	73.9 „ 1.17
15	10.9 „ .51	5.26 „ .19	0.58 „ .04	74.9 „ .69
18	10.8 „ .59	5.23 „ .16	0.55 „ .04	74.1 „ .68
24	9.6 „ .53	5.30 „ .19	0.51 „ .04	73.5 „ .85
36	8.8 „ .41	5.37 „ .17	0.48 „ .03	74.7 „ .84

It would appear that under the conditions prevailing no advantage is gained by planting more than 15 tops per row. This may have been largely the result of the exceptional weather conditions. The practice at the Station is to plant 18 tops per row.

The deplorable quality of the juice is shown by the exceptionally low sugar content. These canes were analysed at the time of reaping and afford an excellent example of the effect produced by the onset of the rains after a prolonged drought.

This effect is doubtless enhanced by the comparatively poor drainage conditions, though it is typical of what was experienced on the estates.

PESTS AND DISEASES.

Borer.

Advantage was taken of the examination of samples at the laboratory for an investigation of the damage caused by borer. This has been carried out under the direction of Mr. L. D. Cleare, Jr., Economic Biologist of the Department of Science and Agriculture. 2,301 samples were checked for borer, involving 612 varieties. It is proposed to reissue the results of this investigation as a Bulletin.

Grass Looper.

A small outbreak of this caterpillar did a certain amount of damage to the transplanted canes on field 5 W. in July. Control was rapidly obtained by spraying with lead chromate. The depredations of this pest on the green manure plants have already been noticed.

Plant Pests.

Sustained efforts have been made throughout the period under review in an attempt to eliminate *Antidesma sp.* and *Cleodendron sp.* A large reduction has been made, but both these plants still rank as pests.

VISITS TO ESTATES.

No visits were paid to estates during the period under review, as it was considered that the examination of the seedlings in cultivation at the Station was of paramount importance. Even from the brief summary of the seedling investigations presented in this report, it will be seen that the results have already fully justified the labour expended.

BUILDINGS.

The building comprising the field manager's office, the watchman's quarters and a half-open shed, which had developed a decided list, has been renovated. The watch-house situated close to the draw-bridge across the Lamaha Canal has been re-erected in the proximity of the office, so liberating the middle room of the office building. The half-open shed portion has been converted into an office for the Superintendent, the walls being constructed of panels of woven split bamboo subsequently plastered with a mixture of Portland cement and sand. At the same time the whole building was raised about 2 feet from the ground, being supported by small concrete pillars.

The Superintendent's office was transferred to the Station in June 1926. It has been found that it is far more satisfactory to have the head office at the Station, a great saving being effected in the time which was formerly spent in travelling. The middle room is now shared by the assistant field manager and the book-keeper.

A telephone service which is directly connected with the Central Exchange has been installed, a branch line giving connection with the laboratory. This has proved to be infinitely more satisfactory than the old arrangement in which all calls had to pass through the Botanic Garden exchange.

A private telephone line between the field manager's office and the watch house at the pumping plant has also been installed.

The laboratory at the Experimental Fields has also been repaired, and of this full account will be found in the chemist's report. It is, apparently, an open question as to whether the Station can look forward to the loan of this building renewed indefinitely. The bench accommodation has already become a limiting factor in the amount of work which can be done in the laboratory. If the Station, and the Sugar Industry of the Colony, is to obtain the maximum benefit accruing from the services of the chemist, a larger building with adequate working space will be required in the near future. So far as the chemical examination of the seedling canes is concerned it would obviously be advantageous for the laboratory to be situated in close proximity to the Sophia navigation canal, so as to avoid double handling and subsequent transportation by cart. The advantages attendant on offices and laboratories being in close proximity are obvious. Residences for the staff and dwellings for the labourers would also help to bring about greater efficiency.

COMMUNICATIONS.

Access to the Station is a matter of some difficulty. The road through D'Urban Park is now practically impassible to wheeled traffic. The Botanic Garden avenue is closed to heavy vehicular traffic in wet weather, and to drays at all times. The Lamaha Canal is now closed to through traffic to the Vlissengen road consequent on alterations carried out in connection with the new water-works. It has been suggested that the new water-works road may be continued to the boundary of the Station. This would be a great boon, since it would give direct access to the office, not only for the Station Staff, and for visitors, but also for vehicles for the transportation of planting material for distribution to the estates. An alternative suggestion originally made by Mr. Clementi,

was that the Sophia Front—Bel Air dam be opened as a roadway so as to give access to the railway line and to the East Coast main road. This would be of especial service for the despatch of planting material to the estates on the East Coast, either by road or rail. At the same time it might serve to encourage planters to visit the Station. If both these roads were opened it is probable that many would call at the Station on their way in or out of Georgetown.

VISITORS.

54 persons visited the Station during the period under review. These included:—Dr. Wilbrink, now Director of the Sugar Experiment Station at Cheribon, Java; the late Dr. C. L. Withycombe, Lecturer on Zoology and Entomology, and Mr. C. V. Shephard, now Professor of Economics at the Imperial College of Tropical Agriculture, Trinidad; and Viscount Peel.

SUMMARY OF DESIRABLE IMPROVEMENTS.

1. The provision of road access to the Station.
2. The installation of a pumping plant capable of removing a rainfall of two inches in twenty four hours.
3. The erection of a laboratory building, with adequate accommodation for both chemical and biological work, and for a library.
4. A collection of the more important scientific literature connected with investigations carried on by the Station.
5. The erection of residences for the Station staff.
6. The erection of dwellings for the labourers.

PROJECTS FOR 1926-1927.

1. Soil Acidity, Aluminium Toxicity and Patchy Infertility of the soil.
2. The Replaceable Bases in Cane Soils.
3. A chemical examination of the permanent manurial plots.
4. Inauguration of a Soil Survey of the Estates.
5. Classification of cane varieties on morphological bases.
6. Stomatal characteristics of cane varieties.
7. Root systems of cane varieties
8. Bibliography of Demerara Seedlings.
9. Collation of experiences with mechanical tillage.

REVISION OF THE ORDINANCE.

2. The following sub-section has been substituted for sub-section (2) of section three of the Principal Ordinance :—

"(2) The said Association may from time to time appoint a member of the Committee to be Chairman of the Committee. The Chairman shall preside at meetings of the Committee and in his absence from any meeting the members present shall choose one of their number to be Chairman of the meeting."

C. L. WHITTLES,
Superintendent.

BRITISH GUIANA SUGAR PLANTERS'

Statement Showing Total Receipts and Expenditure

RECEIPTS,

Balance, 1924-1925	$ 7,424.81
Assessments, 1925-1926	13,855.76
Government contribution in lieu of Assessment on cane farmers	1,000.00
Interest on Savings' a/c	213.57
Refunds	562.79
Sale of Canes...	1,319.27
Other Sales..	55.21
	$ 24,431.41

EXPERIMENT STATIONS COMMITTEE.

for the year ending 30th September, 1926.

PAYMENTS.

MANAGEMENT.		
Chairman	$ 358.33	
Secretary	480.00	
Superintendent	1,220.61	
Chemist	2,503.33	
Field Manager	1,520.00	
Laboratory Assistant	132.00	
Assistant Field Manager ...	728.90	
Clerical Assistant	448.00	
Travelling	531.91	11,226.14
SOPHIA STATION.		
Wages.		
Buildings, Bridges, etc.	435.71	
Nursery	780.86	
General Cultivation	2,305.82	
Extension of Cultivation ...	164.40	
Manures and Manuring ...	163.04	
Reaping, Transporting & Distribution	1,275.51	
Pests	165.12	
Canals and Paths	465.15	
Navigation and Drainage ...	1,061.87	
Irrigation	336.52	
Miscellaneous	581.08	
Office	24.30	
Laboratory	345.54	8,107.92
Expenses.		
Rent and Insurance	1,311.00	
Buildings, Bridges, etc. ...	279.50	
Nursery	37.08	
General Cultivation	15.89	
Extension of Cultivation ...	3.97	
Reaping, Transporting & Distribution	34.51	
Pests	29.30	
Canals and Paths	10.04	
Navigation and Drainage ...	1,293.23	
Irrigation	266.56	
Miscellaneous	125.02	
Office	396.74	
Laboratory	835.00	
Contingencies	321.84	4,959.68
TOTAL PAYMENTS.		24,293.74
Balance in Barclays Bank, Current Account		87.67
Petty Cash on hand, Field Manager		25.00
Petty Cash on hand, Secretary ...		25.00
		$24,431.41

THE ANNUAL REPORT OF THE CHEMIST FOR THE YEAR ENDING SEPTEMBER, 1926.

STAFF

The staff of the laboratory during the last year consisted as previously of the Chemist, Chemist's assistant, and a number of agricultural apprentices.

The number of apprentices employed naturally varies with the amount of work in hand, but during the heaviest part of the work the number was only five.

The quality of the work performed has been maintained up to the standard observed last year, and the keenness which was noticed previously has in no way diminished

The period for which they have worked is given in the following table :—

Name	*Days*	*Name*	*Days*
W. P. David	27	J. Pile	47
M. Lall	216	H. Wren	83
P. O. Jackson	143	W. Bovell	124
H. Kissoon	57	T. B. Persaud	13 (Not an agricultural apprentice; this boy was employed at the request of his parents.)
R. Hoppie	92		

BUILDINGS

In March, 1926, the Public Works Department decided to paint the laboratory and at the same time to make certain alterations. Previously the mill room had been separated from the remainder of the laboratory by a partition against which stood a bench.

For some time past this partition had been found inconvenient, firstly because it prevented proper supervision of the work in both rooms at once and secondly it made the arrangement of benches difficult, thereby wasting valuable space.

The partition was therefore removed and the bench which stood against it was removed to the side of the laboratory. Since this work has been carried out it is found that there is a little more space available and the ventilation of the laboratory is greatly improved.

Owing to the very limited space available for mechanical work in the laboratory, it was thought advisable to have a seperate workshop, since too much valuable bench space was occupied by the tools. Further, the acid fumes which are ever present in a laboratory are highly detrimental to tools.

The only available space for a workshop was a manure shed at the end of the laboratory. This shed was practically rebuilt by the Public Works Department and a concrete floor put down. In addition, a bench running the length of one side of the room was fitted up. It is now possible to perform all mechanical work and repairs under greatly improved conditions.

Electric power has been laid on from the laboratory for driving the lathe which has been mounted on one end of the bench.

This work was in progress from March until May 1926, and in consequence no work could be performed at the laboratory.

Many of the cupboards in the laboratory have had a second shelf fitted in order to provide sufficient storage space for apparatus and chemicals. Each drawer and cupboard has the contents stencilled upon it for the rapid location of apparatus.

The available bench space and storage capacity of the laboratory are quite inadequate for the amount of work which has been done.

MACHINERY

The machinery equipment for cane analysis has in no way been changed.

In October, 1925, the Squier mill broke down, one of the small pinions having worn out. This was replaced and no further trouble was experienced throughout that season.

In August the engine was cleaned and apart from a deposit of carbon on the piston head and valves, the engine was found to be in excellent condition. This engine has given the greatest satisfaction throughout the milling season, having given no trouble whatever during the six months grinding.

The Squier mill again broke down in August and the canes which were being analysed had to be milled on No. 2 mill. The trash plate of the Squier mill was very badly worn and the bar was slightly bent thereby allowing the megasse to pass through with the juice.

As far as can be ascertained the trash plate and bar have given trouble for some years and it has been decided to replace these parts with new ones.

Three new side pinions for the rolls have been fitted since the old ones were very worn and liable to break at any moment.

The dynamo used for supplying power to the laboratory had a slight repair in January 1926, but has given no further trouble since.

An oil bath made from tin plate has been fitted round the shafting pinion and the first gear wheel of the mill. This oil bath, using waste oil from the engine, has done much to reduce the noise and wear of this gear.

Six sets of new washers for the Squier mill were ordered as it was thought advisable to use the correct washers which the makers supply. These washers consisted of slabs of hard rubber without any internal canvas support and it was found that after two or three days use the washers split and were of no further use. This entailed constant renewal of the washers with consequent loss of time.

An experimental washer was made from an old motor tyre outer cover, which is reinforced with canvas, by making parallel cuts along the edge of the tread. This type of washer has been found to work exceedingly well and its life is at least three or four weeks.

Much time has been spent on overhauling and refitting the pumping plant at Sophia. The work actually performed on it has been discussed by the Superintendent.

APPARATUS.

A considerable amount of apparatus and chemicals have been purchased, as in the previous year the work had been considerably hampered owing to lack of equipment. Most of the apparatus consisted of glassware and as far as possible Pyrex glass has been purchased as this material is much stronger in every way than ordinary glass.

A separate bench has been fitted up for the determination of glucose where two assistants are able to work continuously. The necessary reagents are supplied from aspirators connected to automatic burettes and pipettes. This bench is used for soil ignitions when sugar analysis is not in progress.

An apparatus to be employed for sampling a soil suspension in mechanical analysis is under construction. Considerable difficulty has been experienced in the construction as certain parts have had to be sent to a foundry since the lathe at the laboratory was too small to take the work. The quality of the work done on parts sent out was very poor and has caused much trouble in adjustments.

The apparatus consists of a pipette carrier sliding vertically, the motion being obtained by means of a rotating screw and nut. The vertical slide rods were turned locally, and the work being poorly done, have had to be ground to uniformity. A new type of slide has been elaborated which embodies a universal joint connection to the travelling nut, and the motion now is almost without vibration.

The disturbance in the suspension caused by the immersion of the pipette is very much less than when it is lowered by hand. This is of great importance where accurate results are required.

The apparatus is to be mounted on an electric motor which drives the slider, and the whole being mounted on wheels will be able to travel between two rows of jars containing the soil suspensions to be analysed. The aim and object of the apparatus is to enable a large number of soils to be analysed with a high degree of accuracy.

In connection with soil analysis a set of vibrators has been set up for the preparation of the soil suspensions. After trituration with a rubber pestle the suspension is vibrated in a glass vessel provided with a flexible celluloid bottom. The jars rest upon a shelf which has circular openings cut in it, and below each opening is mounted an electric bell movement. The bells (1.5 volt size) are connected in parallel across a 6 volt circuit which is interrupted by a master vibrator mounted on the shelf. Excessive sparking at the contacts is prevented by a 2 M.F. condenser.

The whole bench is thrown into violent vibration which also assists the master vibrator, thereby maintaining a steady frequency. By removing the knob from the bell hammer the frequency was raised from 25 to 90 cycles approximately. The celluloid bottoms of the jars are protected from wear by having a thin metal plate suspended by threads between the celluloid and the hammer. This also enables a larger surface of the celluloid to be set invibration.

The temperature of the bell coils seldom rises more than 20°C above laboratory temperature in spite of the fact that they are being run at a much higher voltage than that for which they are intended.

A water table indicating apparatus has been built on field 7W. Sophia. The apparatus is similar to the one erected at the Experimental Fields so that the two levels

can be compared. The float has been coated with pitch as the acid soil waters set up an electrochemical action and destroy soldered joints.

The Still which was purchased by the late Superintendent has been fitted with a new condenser as the old one was punctured in several places, and a constant level water attachment so that it should need no attention.

Working all day with a large Barthel burner, it will supply 6 to 7 litres of distilled water. This is rather too little for the needs of the laboratory and it will be necessary to install a larger still, preferably of a more efficient pattern.

All apparatus in the laboratory has been catalogued for insurance purposes.

SUGAR ANALYSIS.

The technique of the sugar analysis is the same as that described in last year's report and needs no further comment.

The analysis terminated on the 9th March, 1925, and was recommenced in August for about a fortnight. The total number of analyses performed during the year is 10,599.

The discussion of the results has been dealt with by the Superintendent.

It has been found possible to recover much of the ammonia used in the determination of glucose, and a great saving in expense has been effected. This method of recovery is being extended to soil analysis where ammonia residues are available.

Experiments were carried out to determine the relative difference in power required to mill D.625 canes and new seedlings.

An extended pointer was attached to the fulcrum lever of the engine and a platinoid contact at the distant

end moved over a resistance wire in the form of an arc of a circle. This arrangement formed a simple potentiometer, the mid point of which was determined by the position of the engine governor. Considerable time had to be spent in order to find the most satisfactory resistance of the potentiometer. This potentiometer system was connected to a Callendar recorder, the pen of which traced a curve on an arbitary scale.

The Crossley engine is of the four stroke tpye and each explosion caused a momentary kick on the governor which was magnified by the potentiometer lever. This caused the recorder pen to run backwards and forwards continuously thereby ruining the record. Various adjustments were made but it seemed impossible to overcome the inpulse due to the power stroke.

A direct mechanical method of recording is also useless on this account and an indirect method of attack will have to be made. Experiments are being carried out in this connection in readiness for next season's grinding.

SOIL WORK.

It is unfortunate that only a small amount of soil work has been carried out. For 6 months of the year the laboratory work consisted entirely of sugar analysis when it was impossible to carry out any other experiments owing to the limited accomodation. During the following 3 months the laboratory was under repair and in consequence no work of any description could be performed there. The remaining 3 months of the year the soil work consisted almost entirely of chemical analyses performed on samples sent to the laboratory for examination.

At the break of the drought the water in the side line was noticed to be of a peculiar colour, and also very clear, and it was thought advisable to perform an analysis upon it.

Below is given a table of the complete chemical analysis :—

	% on Water	% on Residue
Total solids	0.235	
Loss on ignition	0.600	23.90
Colloid clay, silica etc.	0.0086	3.41
Sulphates as SO_4	0.0413	16.22
Chlorides as Cl.	0.686	27.29
Carbonates as CO_2	0.0022	0.87
Iron as Fe_2O_3.	nil	nil
Aluminium as Al_2O_3.	0.0033	1.20
Calcium as CaO	0.0095	3.48
Magnesium as MgO	0.0160	5.93

It will be seen that both the chlorides and sulphates are high and these alone are sufficient to cause a drop in fertility in the soil. The importance of thorough drainage and irrigation to remove harmful salts cannot be over estimated.

Sample of soil were received from Pln. Leonora for examination as the fields from which they were taken were infertile. The samples consisted of two sets of Top-soil and two sets of Sub-soil, numbers 1 and 2, 3 and 4 being pairs.

Total and citric soluble analyses were performed on the samples and it was found that the aluminium content was high in all cases. Below are given the results of these analyses :—

Topsoil No. 1	*Total %*	*Citric Soluble %*
Per cent. Matter insoluble in Conc. HCl	64.35	...
Aluminium as Al_2O_3.	16.07	0.93
Iron as Fe_2O_3.	3.40	0.25
Calcium as CaO	0.15	0.06
Magnesium as MgO	0.60	0.02
Potash as K_2O	0.23	0.06
Phosphate as P_2O_5	0.07	0.02

Subsoil No. 2.	*Total per cent.*	*Citric Soluble per cent.*
Matter insoluble in Conc. HCl	72.88	...
Aluminium as Al_2O_3	13.40	0.19
Iron as Fe_2O_3	3.00	0.11
Calcium as CaO	0.04	0.03
Magnesium as MgO	0.18	0.02
Potash as K_2O	0.60	0.10
Phosphate as P_2O_5	0.02	0.001

Topsoil No. 3	*Total per cent.*	*Citric Soluble per cent.*
Matter insoluble in Conc. HCl	73.60	...
Aluminium as Al_2O_3	11.53	0.58
Iron as Fe_2O_3	2.07	0.20
Calcium as CaO	0.40	0.02
Magnesium as MgO	0.34	0.01
Potash as K_2O	0.21	0.002
Phosphate as P_2O_5	0.06	0.01

Subsoil No. 4.	*Total per cent.*	*Citric Soluble per cent.*
Matter insoluble in Conc. HCl	83.93	...
Aluminium as Al_2O_3	8.41	0.16
Iron as Fe_2O_3	1.81	0.13
Calcium as CaO	0.03	0.03
Magnesium as MgO	0.25	0.02
Potash as K_2O	0.36	0.002
Phosphate as P_2O_5	0.05	0.001

It will be observed that in all cases the Aluminium content is high except in the citric soluble No. 4. (This deviation may be due to sampling error), and it is thought that this high aluminium content is the active principle causing infertility. Further work on these lines will be carried out next year.

A sample of soil from Pln. Uitvlugt was treated in a similar manner and below are shown the results :—

	Total per cent.	*Citric Soluble per cent.*
Matter insoluble in Conc. HCl	65.21	..
Aluminium as Al_2O_3	10.10	0.90
Iron as Fe_2O_3	7.88	0.74
Calcium as CaO	0.23	0 12
Magnesium as MgO	0.68	0.12
Potash as K_2O	0.97	0.01
Phosphate as P_2O_5	0.10	0.04
Nitrogen	0.16	...

It appears that the infertility is closely correlated with the aluminium content which is high in all cases. Unfortunately no exact determination of the H ion concentration can be performed as yet since the H ion concentration apparatus is not working satisfactorily.

The line of attack on this problem of infertility will be directed on the determination of the active aluminium and the acidity of the soils.

Owing to the unsatisfactory results obtained by different workers using platinum chloride or perchloric acid in potash determinations, it was thought advisable to try the sodium cobaltinitrite method as recommended by Christensen and Feilberg and also by Dodd.

At first the results obtained were about 20 per cent. too low and it was found that the quantity of sodium nitrite recommended was too small. It seems that the sodium nitrite decomposes slowly in the high temperature prevailing here and a larger quantity has therefore to be used. The results now obtained are very consistent and the method has the great advantage of being cheap.

This method has been adopted as the standard method for potash determinations.

At present owing to the small amount of work which could be performed, it is impossible to give any trustworthy advice concerning the soil problems which have been submitted. It is hoped that next year more work will be carried out since the laboratory conditions are improved and no building operations will be in progress to hinder the work.

A. D. ELMSLY LAUCHLAN,
Chemist.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first quarter of 1927.

The corresponding figures for the same period during previous years and the average for the nine years previous to that are added for convenience of comparison.

Product.	*Average 1916-24.*	*1925.*	*1926.*	*1927.*
Sugar, tons ...	19,848	12,947	20,489	21,615
Rum, gallons ...	852,744	301,355	197,693	223,381
Molasses, gallons ...	23,075	16,717	170,124	861,839
Cattle-food (Molascuit) tons	431	458	266	211
Cacao, cwts. ...	10	None	None	None
Citrate of Lime, cwts.	18	None	None	None
Lime Juice, gals. ...	435	None	None	None
Essential Oil of Limes, gals. ...	22	None	None	None
Coconuts, thousands...	782	305	293	42
Coconut Oil, gals. ...	6,214	6,608	9,019	5,852
Copra, cwts. ..	1,044	4,159	16,169	4,040
Coffee, cwts. ...	1,941	1,779	4,882	1,142
Kola-nuts, cwts. ...	1	None	None	None
Rice, tons ...	3,117	2,324	1,534	2,183
Ricemeal, tons ...	13	None	None	None
Cattle, head ...	101	283	11	4
Hides, No. ...	1,459	3,119	2,553	1,398
Pigs, No. ...	91	361	122	178
Sheep, head ..	5	None	None	1
Balata, cwts. ...	2,410	2,887	3,902	478
Charcoal, bags ...	11,950	7,981	7,636	8,541
Firewood, Wallaba, etc., tons	2,026	1,901	1,792	2,339
Gums, lbs. ...	1,312	None	866	None
Lumber, ft. ...	49,604	13,695	95,261	45,405
Railway sleepers, No.	3,755	20,613	3,425	4,912
Rubber, cwts. ...	31	None	74	98
Shingles, thousands	416	299	370	459
Timber, cub. ft. ...	30,396	49,604	71,922	23,651

Meteorological Data—January—March 1927.

Recording Stations & Months.	Rain-fall. Total Inches.	NUMBER OF DAYS OF RAIN: Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1.00 Inch to 2·00 Inches	Above 2.00 Inches	Total days.	Evaporation. Inches	Air Temperature and Humidity. Air Temp. Maximum.	Minimum.	Mean	Humidity. Mean
Botanic Gardens.												
January...	18·52	5	9	3	2	4	23	3 53	83 8	74 0	79 3	82 6
February	8.34	4	10	3	1	1	19	3 93	83·9	75 2	79·5	80·7
March ...	1 86	3	2	2	...		7	6 06	85·0	75 8	80 4	75·9
Totals	28·72	12	21	8	3	5	49	13 52				
Means.	...	...	...	...	...	...	...	...	84 2	75 3	79 7	79.7
Berbice Gardens.												
January...	27·78	8	7	4	3	6	28	.	85 2	73·5	79 3	81·2
February	14 16	2	7	3	2	2	16	...	85 6	73 5	79 5	80 0
March ...	3·18	6	7	2	...	...	15	...	87 5	73·8	80·6	76·5
Totals	45 12	16	21	9	5	8	59	...				
Means.	.	...	..	...	...	...	...		86·1	73 6	79·8	79·2
Onder-neeming.												
January..	22 10	1	10	4	3	4	22	...	89 0	74 0	81·5	..
February	20·01	2	5	2	3	4	16	...	89 0	73·0	81 0	...
March ...	1 21	. .	2	1	..	...	3	...	89 0	74 0	81 5	...
Totals	43 32	3	17	7	6	8	41	...				...
Means.	...	...	...		...	...	..	...	89 0	73 7	81 3	...
Morawhanna. N W .D												
January.	10 60	1	8	4	1	2	16	...	..	..	...	..
February	14.74	2	9	8	4	1	24		...	...	...	...
March ...	2·61	3	7	1	...	..	11	...	...	...	...	...
Totals ...	27·95	6	24	13	5	3	51	...	...	...	...	...

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,726
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,209
1916 ..	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	1,4617
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...	5,671	1,968	1,642	2,629	1,949	2,539	1,610	18,008
1922 ...	3,557	1,841	1,105	1,593	1,525	1,522	1,397	12,950
1923 ...	4,038	2,780	1,595	1,934	1,953	2,137	1,951	16,388
1924 ...	4,123	2,827	1,103	1,789	1,678	2,146	1,664	15,330
1925	3,317	2,755	1,580	1,819	470	1,663	1,597	13,201
1926* ...	1,732	2,627	1,219	2,172	364	1,268	1,600	10,982
1927	414	768	346	683	266	598	598	3,673

* Decrease in attendances caused by very unfavourable weather conditions.

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A MESSAGE TO AGRICULTURISTS.

I wish to take this opportunity of expressing my thanks for the warm welcome which has been extended to me on all sides since my arrival in the Colony to assume the duties of Director of Science and Agriculture.

Following in the footsteps of such an illustrious predecessor as Sir John Harrison, I well recognize that much will be expected of me. I am confident, however, that with the co-operation and goodwill of the whole agricultural community coupled with patience and persistence, the difficulties will not prove insuperable.

It must be remembered that agricultural conditions in this country are unique in so far as the British Colonies are concerned, and the land problems to be solved are very different from those usually met with; it follows therefore that our requirements in certain directions will be different. This fact is not often sufficiently understood, hence progress has been relatively slow *vis à vis* many other Colonies of lesser size and importance.

It will be my constant aim and ambition to serve the agricultural interests of the Colony to the best of my ability, and I beg to assure you of my sympathy in the problems confronting us, and the assistance of both my staff and myself whenever such is needed. The Department after all is yours, and it is my earnest desire that you should make the greatest use of it.

Yours faithfully,

J. SYDNEY DASH.

July, 1927.

MEMORIAL TABLET

TO

SIR JOHN HARRISON.

"*Simplicity of character is the natural result of profound thought.*"—*Hazlitt.*

The ceremony of unveiling the Tablet erected to the memory of the late Sir John Harrison, by the officers of the Department of Science and Agriculture, was performed by His Excellency the Governor, Sir Cecil Rodwell, K.C.M.G., on the afternoon of June 14th, 1927, in the Botanic Gardens, Georgetown.

The occasion was marked by solemnity and a simplicity, in fit keeping with the character of him in whose honour all had assembled. In addition to His Excellency the Governor and his Aide-de-camp, Captain A. D. M. Stayner, there were present—the Hons. C. D. Douglas-Jones, C.M.G., (Colonial Secretary), Hector Josephs, K.C., B.A., LL.M., (Attorney-General), Dr. P. James-Kelly (Surgeon-General), R. E. Brassington, N. Cannon, J. Hampden-King, C.B.E., (Immigration-Agent-General). Messrs. W. Francis, F.I.C. (Acting Director, Department of Science and Agriculture), A. R. F. Webber, F.R., E. F. Fredericks, LL.B., F.R., A. E. Seeram, F.R., Colonel W. E. H. Bradburn (Inspector-General of Police), Major Bain-Gray Ph.D., B. Litt. (Commissioner of Education), Captain Edgar Beckett, F.L.S., Messrs. J. Wood Davis, A. D. E. Lauchlan, B.A., S. Bracewell B.Sc., R. A. Altson, B.Sc., S. H. Bayley, H. A. Britton, J. W. Mearns, J. J. da Silva, M. P. Camacho, A. T. Phillips, Dr. S. N. Bruce, the Misses A. Jardim, J. Pestano, and O. Bardon, Messrs. L. D. Cleare, Jnr., F.E.S., F.L.S., E. M. Peterkin, L. S. Davis, A. A Abraham, C. C. Dowding, W. H. Matthews, D. D. Blackman, T. Archer, J. N. Antrobus, D. Haynes, Indro Beharry, D. Iloo, J. Leitch, N. Persaud and C. L. C. Bourne

The original idea of the officers of the Department was to present Sir John on his retirement with a piece of plate, suitably inscribed. His lamented death in February, on the eve of his retirement, made this impossible. It was decided to erect a Memorial instead, and permission having been obtained, it was resolved to erect a brass tablet, mounted on oak, and place it in position just below the clock erected to the memory of the late Government Botanist, George Samuel Jenman, F.L.S., his old friend and colleague.

The staff are grateful to Mr. J. Wood Davis, through whom the tablet was obtained, and take this opportunity of thanking him. For 36 years Sir John Harrison served British Guiana, he was the first Director of the Science and Agriculture Department, a position which he held for one and twenty years.

Mr. Francis opened the proceedings by asking His Excellency the Governor, on behalf of the officers of the Department of Science and Agriculture, to unveil the tablet.

His Excellency said that the occasion was not one which demanded from him any ornate or lengthy panegyric. Indeed, he could imagine few things more distasteful to him in whose honour they had assembled, than a laboured recital of his many achievements and virtues, but a brief reference might be permitted. Of his many achievements, probably there was none more valuable to British Guiana than his experiments in connexion with the Sugar Cane and the establishment of a Sugar Cane Experimental Station. It was proper that in these Gardens, where his experiments were carried on and where the first Experimental Station stood, they should put a final tribute to his memory. Of his many sterling qualities those which His Excellency believed chiefly impressed his contemporaries, and certainly were apparent even to those who only knew him slightly, and at the end of his career, were his devotion to duty, his singleness of purpose and his intolerance of anything that savoured of guile or duplicity. A notable figure in truth and a great servant of the Colony and of the Empire.

The Memorial he was about to unveil had been well chosen. In the severe simplicity of its style, it symbolised faithfully the character of the man whom it commemorated —a plain brass tablet mounted upon a plain slab of English oak. Of Sir John Harrison it might truly be said.

Illi robur et aes triplex
circa pectus erat x x x.
x x x
x x x x x
x x
x x x x x x
x x x x
x x x x x x
Quem mortis timuit gradum?

His Excellency then unveiled the memorial by drawing aside a Union Jack covering the tablet which bore the following inscription.

TO THE MEMORY OF
PROFESSOR SIR JOHN BURCHMORE HARRISON,
KT., C.M.G., M.A., F.I.C., F.C.S., F.G.S., F.G.S.A.,
DIRECTOR OF SCIENCE AND AGRICULTURE, GOVERNMENT ANALYST AND GEOLOGIST, WHO DIED ON THE 8TH FEBRUARY, 1926, THIS TABLET IS ERECTED BY THE OFFICERS OF THE DEPARTMENT OF SCIENCE AND AGRICULTURE AS A TOKEN OF APPRECIATION OF HIS STERLING ABILITY AND LONG AND FAITHFUL SERVICE OF 36 YEARS TO THE COLONY OF BRITISH GUIANA.

Mr. Brassington then said :—Your Excellency, ladies and gentlemen, I have been asked to move a vote of thanks to your Excellency for coming here this afternoon and unveiling the Memorial Tablet to Sir John Harrison. Perhaps it

would not be out of place for me to say that as a sugar planter of many years' experience, there was nobody in the profession—and I say Agriculture is a profession—who would deny that Sir John Harrison rendered invaluable service to the Sugar Industry. I do not think it is generally appreciated by the planters exactly, the full value of what his services were to the Industry. As your Excellency has so eloquently said, Sir John Harrison was a man who disliked anything that savoured of what one might call "frills." He was a tireless worker and there can be no doubt about it that his name will always be linked up with the scientific achievements in agriculture of his Department. On behalf of everyone here I desire to say we are very pleased to see your Excellency here this afternoon. You are, if I may so term it, the first practical agriculturist who has been Governor of this Colony, and you are giving a practical demonstration of that by what I may term going into the ranks of the local proprietors at your Plantation Cecilia at Enmore. We only hope that Your Excellency's plantation there will set an example in what may be done in other branches of agriculture than sugar, rice, coffee and cocoa. I again thank Your Excellency for attending here this afterooon.

Mr. Cannon then said :—Your Excellency I have been asked to say a few words in support of what Mr. Brassinghas said. I do not think there is anything much I can add to what he has said. I think we all know the value Sir John Harrison was to this Colony and no words of mine can add to his deeds.

His Excellency then departed, and the gathering dispersed.

GROUND NUT CULTIVATION.

Visit To Governor's Model Plot.

His Excellency Sir Cecil Rodwell, K.C.M.G., attended by his private secretary, Lt. Colonel H. H. Johnson and accompanied by Professor J. Sydney Dash, Director of Science and Agriculture, paid a visit to his ground nut cultivation at Plantation Cecelia, Enmore, E.C., on Wednesday, the 27th July. Mr. C. C. Dowding, Resident Agricultural Instructor who inspects the cultivation, and Mr. E. Beckett, Agricultural Inspector, were also in attendance.

In response to an open invitation the following were present: Messrs J. Veerasammy, W. Mearns, C. H. Easton, H. L. Humphrys, C. C. Roberts, J. R. Muss, H. A. Thompson, J. J. T., J. A. and Colin Adams, S. E. A. Talbot, P. M. Walker J. L. Griffith, Fitz Greaves, H. W. Matthews, D. Profitt, H. M. Nehaul, J. Damon and Mrs. S. McGarell.

The Cultivation.

On the instruction of His Excellency, Mr. Dowding gave a description of the cultivation. He said that the area under cultivation was approximately two acres. It was divided into two sections, the east and west section. The eastern section was sub-divided into an eastern, middle and west portion.

The first two beds of the northern side of the east, middle, and west sub-sections were planted with the Virginia Runner variety at a distance of one foot apart in the rows, and 30 inches between the rows. The next four beds were also planted with the same variety, but at a distance of 18 inches in the rows, the space between the rows being the same. The remaining portion of the east sub-section was planted with the Chinese variety. These failed to germinate satisfactorily on account of the heavy nature of the sub-soil. Subsequently the area in question had to be replanted with the Virginia Runner variety at a distance of two feet in the rows, the distance between the rows being the same. The middle and western sub-

sections were planted with the Virginia Bunch variety at a distance of eight inches between the rows. Five small plots in the middle sub-section were also planted with the same variety at a distance of eighteen inches in the rows.

The entire western portion of the cultivation was planted with the Chinese variety in the following manner: on the southern side, twelve flat ridges were planted at a distance of one foot apart between the rows; one bed eleven feet wide, 18 inches apart; another of the same width, 15 inches apart: three of same width, one foot apart; eight beds, five feet wide, one foot apart; two beds, five feet wide, six inches apart; two thirty-inch flat ridges, six inches apart; and six thirty-inch ridges, one foot apart.

Preparation of Seeds.

With regard to the preparation of the seeds of the Chinese variety on the western portion, the treatment was as follows: They were soaked in water for 24 hours in order to soften the shell, taken out and allowed to drain for an hour and then planted in the shell. Some began to germinate on the eighth day and others never came up until the fourteenth. The seeds of the Virginia Runner and the Virginia Bunch varieties were soaked in formalin for four hours so as to destroy any fungi; they were then shelled and planted. The weather conditions were favourable and some of them began to germinate in 84 hours. The Chinese variety were shelled and planted on the northern portion of the east and middle sub-section; but owing to the fact that the land was very low, and had to be built up with sub-soil, the majority did not germinate; and the land had to be reforked and replanted with seedlings of the two other varieties. Great care was exercised in the selection of the seeds; and in the low and compact portions of the land, ridges had to be made. The width of the beds had also to be varied owing to the varying texture of the soil encountered.

Address by Director of Agriculture.

His Excellency then invited Professor Dash to speak, who said that he was pleased to come and see the great

effort His Excellency had made: it had certainly exceeded his expectation. He could only refer to matters in a general way. The best method was to learn by beginning.

He then gave a short impromptu talk on peanut cultivation, the substance of which is as follows:

In recent years there has been an increased demand for vegetable oils; it has long been recognised, of course, that the peanut possesses considerable value from this point of view. The cultivation of the plant requires a fair amount of labour to handle it, especially if grown on a large scale. As there are several labour-saving implements, the labour bogey should not deter any one from engaging on its cultivation, provided the soil conditions for their efficient use exists.

The plant is a legume, and the only one of its kind that turns its flower into the soil after it has been fertilised. The reason for this peculiarity has not yet been determined. It has been fairly well established that the plant is a native of Brazil, and this would seem to indicate that it can be grown successfully in this colony; whether economically or not is a matter for investigation.

It is cultivated largely in the United States and such British territories as the Madras Presidency and those in Africa, also in China and Japan. It is curious to note that the labour for handling the commodity in the African possessions is largely supplied from the neighbouring French territories.

In Africa, the question of freight, so far as exporting is concerned, is not as serious as in some countries owing to the comparative nearness of the market: hence the nuts are shipped in the shell which ensures a better quality. The possibility of shipping in compressed bales has been suggested in order to reduce space and consequently freight. The demand for peanuts in America is greater than the supply and imports are made from the East. The Americans consume a large quantity directly and convert the surplus into oil and peanut butter. In Europe the bulk of the imports is converted into oil.

SOIL.

The best soil in which to plant peanuts is a friable and light one—a sandy soil, as reaping is carried out more advantageously. Nuts grown on stiff clayey soils are discoloured and expensive to reap. Discoloured nuts have to be bleached where they enter into direct consumption, appearance being an important consideration.

Soils extremely rich in nitrogen are usually unsuitable, a large percentage of the pods of plants grown on such soils contain no nuts. It is essential that a proper balance of minerals be maintained, especially lime, in order that vegetative production may not take place at the expense of fruiting.

Peanuts should not be grown continually on the same soil. There should be proper rotation, or the yield of oil from the nuts may be diminished, and without rotation the crops are more liabie to pests and disease.

In the case of the cultivation of pasture land, it will be noticed that a good crop of weeds springs up after ploughing. That is due to the fact that the seeds of such weeds are lying dormant in the soil waiting as it were for an opportunity. The best means of combating weeds is to smother them. While their germination cannot be prevented, the shading prevents them from obtaining light, and consequently they die. No cover crops apparently have been developed here so far as he had seen. Bengal beans make an ideal cover crop. Their stems and leaves could be turned into the land or used as fodder. In Trinidad they are now being tried for the purpose of taking the place of some of the grasses as fodder. While planting closely may often reduce the yields of plants generally, yet at the same time the weeds are materially kept down and at minimum cost. Peanuts may be planted either flat or in ridges, depending on the soil conditions. A point in favour of ridge planting is that the soil thereon is loose; but the ridges should be low and not too high so as to prevent excessive drying out of the moisture.

Harvesting.

Employers of labour should calculate before-hand the cost of labour, taking into account the kind of soil, the average ability of each labourer and the time in which the reaping can be completed. The work should be done rapidly and planting should be arranged with a view to ensuring suitable reaping weather. Harvesting in heavy rains ruins the crop by causing the nuts to germinate. The stems are relished by all classes of live stock and are used in several places as a substitute for hay.

Grading.

This is now being done in connection with all kinds of products. Agriculturists resent the idea of having their crops graded, but they are gradually being brought to recognise its value. As proof of the necessity of grading it may be stated that the contents of a bag or bale of any commodity is judged by the poorest sample and not the best, and it is useless to suppose that by mixing good and bad, the producer reaps any advantage in marketing. There should be the closest possible co-operation in such matters. It is practised to a large extent in the United States where co-operative methods in agriculture have increased by leaps and bounds, notably since the war. The number of associations has increased from approximately 6,000 in 1915 to double that number at the present time. The total volume of business transacted by them is roughly two and a half billion dollars. There are a number indeed which sell farm products annually to the extent of fifty million dollars each. Co-operation, in brief, is the exchange of ideas with beneficial results.

His Excellency then thanked Professor Dash for his address, which, he said, was interesting and illuminating although impromptu. He then asked the Professor if there were more varieties of nuts as he had been only able to get three. Professor Dash replied that the number was very limited only about four or five being listed. His Excellency also enquired about implements and was told that in the United States where the cost of labour was very

high, certain implements were used for harvesting and threshing.

Mr. Humphrys inquired whether the nuts could be planted during the slack seasons on the sugar estates.

Professor Dash said that the great point to consider was the planting of the nuts at a time which would ensure harvesting than in the dry weather.

Mr. Thompson said that a number of the small farmers had found their ground nut cultivation destroyed by red ants and wanted to know how the pest could be destroyed. In reply, Professor Dash said whenever new crops were reared, new pests were discovered, and he would be glad to see the specimens of the pest complained of. Travelling was difficult and expensive, and he would welcome the co-operation of the farmers in this respect. Mr. Beckett said that carbon bi-sulphide was effective and was being used at the present time.

In reply to a question by Mr. Colin Adams, Professor Dash stated that in St. Vincent the nuts were usually washed and thoroughly dried, but there the industry was entirely in the hands of the peasantry. Mrs. McGarell asked how long it was before the nuts were harvested.

His Excellency said jocularly that he could answer that question—the time was 4 to $4\frac{1}{2}$ months.

Mr. Muss asked that apart from discolouration what was the difference in nuts produced in clay soils and those in sandy soil.

Professor Dash answered that he did not think there was much from a scientific point of view ; though economically, as he had said before, there was the difficulty of reaping.

THE RICE MOTH-BORER (*Diatraea saccharalis* F.,) AND RECOMMENDATIONS FOR ITS CONTROL.

By L. D. Cleare, Jnr., F.L.S., F.E.S.,
Government Economic Biologist.

The rice crop of the Colony has suffered somewhat within recent years from the attacks of an insect known as the Rice Moth-Borer, which in some districts has inflicted appreciable losses. This insect also attacks sugar-cane and is one of the well-known "borers" which causes severe damage to that crop, and which it has been proved is a difficult insect to control. The damage caused by this insect has increased recently, and unless steps are taken by all rice growers to combat the pest, it is believed that the loss inflicted by it will rise materially, and may affect seriously the production of rice in this colony. It is essential, therefore, that every effort should be made to control this insect when attacking rice.

The moth, which is a straw-coloured insect of about three-quarters of an inch in length, lays its eggs upon the leaves of the rice plant. From these eggs caterpillars emerge which bore into the rice stalks, and when fully grown measure about an inch long. It is this stage of the insect that causes the damage to the crop. Stalks that have been bored by the caterpillar may either break off and fall to the ground and thus fail to produce flowers and grain, or, if the flowers have already formed, they will fail to produce grain. In this way many stalks that would otherwise produce grain fail to do so, with a consequent reduction in the yield of paddy.

As the result of investigations recently undertaken the following preliminary recommendations have been drawn up for combating the pest.

In districts where two crops of rice are grown a year, and which possess an adequate and dependable water supply, it is recommended that the stalks should be cut

low, within a few inches of ground, at the time of harvesting the crop. The fields should then be flooded again immediately after harvesting, so that the remaining stubble it submerged. Or, if the paddy is cut short when reaping, and long stalks consequently left standing in the fields, these should be cut within a few inches of the ground immediately after harvesting has been completed, by means of a scythe or other implement, and the fields, together with the stalks thus cut down, then submerged as before.

In districts where only one crop of rice is grown it is recommended that, if the old stools do not die readily, they should be ploughed out. The fields, if left fallow after reaping, should be ploughed again at least two weeks before planting in order to remove and bury all heavy grasses and "volunteer rice" and then completely submerged in water. The planting of a suitable crop as a rotation between two rice crops is also recommended. This not only would aid materially in the control of the moth-borer, but would improve the condition of the soil and make for larger yields. There would be the additional advantage of the production of another crop during the period that the land would otherwise lie idle. A suitable crop for such rotation would be a pulse, and for this purpose either Green-Gram or "Mung" (*Phaseolus mungo*), "Black Eyes" (*Vigna sinensis*, var.) "Increase Pea," or some similar pea is suggested.

Rice straw, after the separation of the paddy therefrom, should be returned to the beds and, either ploughed into the soil, or, after first damping it at the "mashing out" places, or "carians," should be submerged in the bed. The burning of rice straw after the separation of the grain is not recommended as a method of disposal of this material, although it is now practised in most parts of the colony. When practised over a number of years there can be little doubt that this method of disposal of rice straw seriously affects the yields of the crop, as may be observed already in some rice growing areas on the coastlands.

"COCKLES" IN THE NORTH WESTERN DISTRICT.

In July, the Government Economic Biologist visited the North Western District in connection with a report of an outbreak of "cockles." A number of farms in the district were seen and investigations carried out on the insect. Mr. Cleare reports that the insect concerned is a beetle, *Ligyrus ebenus* De G., which at times also causes injury to sugar-cane on the coastlands although of comparatively minor importance to that crop.

The principal crop affected in the North Western District, was Tannias, which are extensively grown in that district, and at the time of the visit it was the adult insect that was causing the damage. The beetle bores into the sets or "bottoms" soon after they are planted, thus inflicting serious damage and often completely destroying them. For this reason planting is, as a rule delayed, and the farmer seriously handicapped.

Investigations revealed the fact that the insects are also injurious in the larval stage, known as "white worms" in the district but more correctly "white grubs," but at the time this stage had already been passed, and, as already mentioned, only adults were to be found. It was also observed that White Tannias appear to be less injured than Yellow Tannias, although not entirely free from attack.

Owing to the lateness in the season, investigations could not be further pursued, and it is proposed to visit the district early next year in order to continue inquiries into the insect. In the meantime, a number of adults have been secured, and laboratory investigations on the pest are being undertaken.

THE CULTIVATION OF CITRUS FRUITS.

Mr. H. Harold Hume has recently issued a new text book bearing the above title. It is published by Macmillan & Co., and the price is one guinea. The subject is of such importance at the present time that opportunity is being taken to review the book at some length and to offer such comments as may appear necessary in dealing with the subject matter in special reference to tropical conditions.

The volume is intended to take the place of a previous one—Citrus Fruits and their Culture—by the same author. The new work embodies many of the useful features of the old, but covers the ground more thoroughly as a result of the knowledge gained since 1904. The volume may be regarded as an up-to-date treatise covering every phase of citrus activity. Indeed, there is hardly any text book of tropical import recently issued which will be read with greater interest and appreciation. No pains have been spared to make it both comprehensive and authoritative, and although primarily for Florida conditions, it can be recommended with confidence as a general text book on the subject of citrus.

Students of the botany of citrus and the variety question generally will find in the treatment of the subject a considerable improvement on the older work, the chapter on limes being perhaps the only one which might have received fuller attention in view of the importance of finding varieties resistant to the Wither-Tip Fungus and to which only very scant reference is made.

In respect to commercial citrus varieties, emphasis is laid on the change towards simplification especially in the matter of numbers with a view to greater uniformity of product, while such factors as season of ripening, market qnality, resistance to pests and diseases are receiving greater

consideration than they have in the past. In Florida the following varieties are now favoured :—

Sweet Oranges : Parson Brown, Hamlin, Pineapple, Valencia, Lue Gim Gong.

Mandarin Oranges : Satsuma, Dancy, Temple and King.

Grapefruit: Triumph, Duncan, Marsh Seedless, and McCarty.

The McCarty grapefuit is highly recommended as being of excellent quality, and it also has the very desirable feature of producing its fruit singly and not in bunches, thus ensuring a good exterior appearance. The presence of seeds in grapefruit, it is pointed out, makes little difference from the consumer's point of view, but may be objectionable if the fruit is to be held very late on the trees as the seeds may germinate and spoil the flavour. Useful information on judging citrus fruits follows the discussion on varieties.

Propagation methods are adequately dealt with in a book of this size, one chapter being devoted to stocks for citrus, mainly sour orange, rough lemon, trifoliate orange, pomelo and sweet orange. In regard to the question of bud variation, reference is made to the work of Shamel and his associates in California, which has served to emphasize the need for care in bud selection. At the same time, some of the conclusions reached have been questioned by a number of leading horticulturists, it being clear that all variations cannot be attributed to bud sports ; variability in size and shape of fruit, thickness of peel, colour, seediness, vigour and yield, noticeable in whole trees, parts of trees or single branches may be brought about by differences in stocks, moisture, soil, food supply, and many other imperfectly understood environmental factors. Many more years of experimentation will be necessary before definite conclusions can be reached on all the points involved ; in other words, we have here the old problem of differentiating between true variations and fluctuations due to environmental factors. In the meantime, however, the grower cannot afford to be lax in his efforts to propagate only from the most carefully selected scions.

The discussion on soils, location, preparation and planting, contain much sound advice and instruction which should be appreciated especially by beginners in the art of citrus culture; the importance of wind-breaks is stressed, and in this connection it may be noted that in Florida the bamboo, Camphor tree and Casuarina find a place.

Dealing with the cultivation of citrus groves, we note with pleasure the author's condemnation of clean culture as opposed to such measures that have for their object the maintenance of the soil humus. Under tropical conditions, clean cultivation and no attention to the vegetable matter content of the soil inevitably lead to disastrous results; the trees become debilitated and prone to numerous pests and diseases. In Florida, cultivation along with the free use of cover crops appears to be the safest practice. The plants recommended are beggarweed (*Desmodium tortuosum*), *Crotalaria striata* and *C. retzii* and a non-climbing velvet bean (*Stizolobium* sp.).

There is perhaps no tropical orchard crop that responds so readily to fertilizer treatment as citrus, and the author's recommendations should be carefully studied. In connection with sources of plant food, he rightly points out that stable manure should be used with caution, indeed any organic nitrogenous manures as they are not usually well-balanced and need additions of minerals, notably potash, for best results. Unbalanced manures are apt to produce thick-skinned fruit, full of rag, insipid, and lacking in character. On the other hand, stable manure may be of great assistance in putting new growth into starved and neglected trees. Of commercial fertilisers, nitrate of soda and sulphate of ammonia alternately as sources of nitrogen, ground bone and acid phosphate supplying phosphoric acid and the sulphates of potash have given the most satisfactory results in Florida. For young trees, a fertilizer containing 6 per cent. phosphoric acid, 9 per cent. potash and 4 per cent. ammonia is necessary and for bearing trees one containing 8, 10 and 3 per cent. respectively. On poor soils, a half pound of fertilizer for each young tree should be incorporated at the time of planting, followed 4 months later by an additional pound; these amounts may be increased

in the second year and until bearing stage is reached. When fruiting begins the formula should be changed to the one advised for bearing trees. Thus, trees producing 10 boxes of fruit should receive 30 to 50 lb. of the mixture each.

Under more tropical climatic conditions than Florida, where there are heavy rains and high soil temperatures with attendant leaching of fertilizers and rapid destruction of organic matter, the whole aspect of economic treatment of commercial citrus orchards with special reference to manures and maintenance of fertility will need careful thought and investigation. At any rate the most successful tropical orchardists have learned fully to appreciate the value of the organic mulch as an important factor in the permanent health and productivity of their trees. Its efficiency naturally depends on the frequency of renewal, and where green crops cannot be successfully grown in the orchard to produce the necessary quantity, it has often been found practical to utilize waste areas adjoining in the growing of grasses and such material as can be easily brought in for the purpose. Where such conditions are maintained the addition of mineral fertilizers (phosphates and potash) is much more likely to be profitable. Finally, while clean cultivation cannot be regarded with favour, every effort should be made to prevent the formation of turf in the orchard, to which the roots of most citrus trees are intolerant.

The pruning of citrus does not assume the same importance as is the practice with many other fruit trees, the early stages of growth requiring most attention in regard to this operation; that is, the time when the general shape of the tree is being considered—whether a high or low-headed type is the object in view. While extremes in either direction are to be avoided, low-headed trees possess, economically speaking, many advantages over tall trees. These points are succinctly discussed in a short chapter of the book under review.

Handling the citrus crop, as is natural to expect in a work of this kind, receives fairly complete treatment; and while there is nothing new to note under such topics as

picking and picking equipment, we would commend for study, particularly by those new to the subject, the pages dealing with packing and handling—washing, drying, grading, and colouring—at the packing houses. An important change has been the disappearance of the small individual packing house and the development of larger plants, resulting in standardization of methods and greater uniformity in the final product.

The old plan of sweating or curing oranges and grapefruit has been abandoned, the fruit being handled now as rapidly as possible ; the only curing the fruit may receive occurs during temporary stoppages or in transit. The bulge pack has been evolved to make good any slackness from curing shrinkage after packing. When finished, the fruit in a well-packed box is practically level at the ends, but at the centre it is sometimes up one to one and one-half inches above the sides of the box, even two and one-half inches being permissible. In getting this bulge, advantage is taken of a slight variation in sizing the fruit, the larger fruits being worked towards the centre of the box.

Four chapters on pests and diseases with methods of control in practice complete the book. The reviewer has not thought it necessary to refer in detail to irrigation and frost considerations, both of which subjects find a place in its pages. The volume is efficiently illustrated and well-printed and is assured of a prominent place on the bookshelves of all those interested in citrus culture.

J. SYDNEY DASH.

HE PRINCIPAL VARIETIES OF SUGAR CANE IN BRITISH GUIANA UNDER CULTIVATION DURING 1925, 1926, 1927.

By the Director of Science and Agriculture and the Secretary of the British Guiana Sugar Planters Experiment Stations Committee.

Variety.	1925.	1926.	1927.	Increase or Decrease on 1925.	
	areas in British acres.			Increase.	Decrease.
D. 625	37,413	39,193	40,689	1,496	
Bourbon	323	362	257		105
D. 625 mixed with Bourbon & other seedlings	9,201	8,300	8,576	276	
D. 145	2,649	2,854	2,370		484
D. 118	1,576	1,891	2,057	166	
R. P.8	461	285	232		53
B. H. 10 (12)	190	226	217		9
B. 208	403	204	184		20
D. 109	127	116	164	48	
P.L. 2	103	139	105		34
Diamond 37	316	154	69		85
Diamond 10	5	34	65	31	
D. 419	84	70	63		7
Diamond 581	55	29	29		
D. 167	51	37	19		18
Small areas under other varieties & areas under varieties unenumerated	433	206	93		113
Total Estates' Canes	53,390	54,100	55,189	2,017	928
Total Farmers' Canes *	3,800	3,400	3,400		
Totals	57,190	57,500	58,589	1,089	

* *Includes* areas at Plns. Hope & Anna Regina.

The following table indicates the relative distribution of the various kinds of cane during the crops of 1921 to 1927 inclusive.

Variety.	For Crops of						
	1921.	1922.	1923.	1924.	1925.	1926.	1927.
D. 625	56·5	59·4	65·4	70·4	70.1	72.5	73.7
Bourbon	3·5	2·5	2·7	0·7	0·6	0.6	0,5
D. 625 mixed with Bourbon and other Seedlings	13·9	15·2	11.5	13·5	17·2	15.5	15.5
D. 145	7.5	7·3	7·1	6·6	4·9	5.2	4.3
D. 118	4.8	4·1	3·6	3·1	2·9	3.5	3.7
R.P. 8	1·6	1·3	1.5	1·0	0·9	0.5	0.4
B.H. 10 (12)	0·2	0·3	0·4	0·6	0·3	0.4	0.4
B. 208	3·4	3.0	2.0	1.2	0·8	0.4	0.3
D. 109	0·5	0.5	0·3	0·2	0·2	0.2	0.3
P.L. 2	—	0·1	0·1	0·1	0.2	0.2	0.2
Diamond 37	0·2	0.3	0·6	0·7	0.6	0.3	0.1
D. 419	2·7	1.6	1·1	0·2	0.1	0.1	0.1
Diamond 185	1·3	1.0	0.9	0·3	—	—	—
Ba 6032	0.3	0·4	0·5	0.3	—	—	—
Small areas under other varieties, and areas under varieties unenumerated.	3·6	3·0	2·3	1·1	1·2	0.6	0.5
	100.0	100·0	100·0	100·0	100.0	100.0	100.0

From the returns supplied by the Sugar Plantations, the distribution of the various sugar canes in cultivation for the crops of 1921 to 1927 inclusive, according to their origin is as follows:—

Variety.	1921	1922	1923	1924	1925	1926	1927
Bourbon and other old Varieties	8·8	8 2	9·2	4·8	5·1	5.0	4.2
Java	1·1	0·4	0·1	0·1	0·1	—	—
Barbados	4·4	4·1	3·2	2·2	1·4	1.0	0.7
British Guiana:—							
Plns. Diamond & Providence	3·3	3·5	3·7	2·6	2·2	1.2	0.9
Botanic Gardens	82.4	83·8	83·8	90·3	91·2	92.8	94.2
	100·0	100·0	100·0	100·0	100·0	100,0	100.0

The average yields in tons of commercial sugar per acre of the principal varieties reaped during the crops of 1922 as deduced from the returns supplied by the managers of the sugar plantations were as follows :—

	PLANTATIONS		TONS SUGAR PER ACRE	
	No Reporting	Areas reported in acres.	Mean	Maximum
D. 419	2	68	2.30	3.00
B. H. 10 (12)	3	166	2 26	2.54
D. 118	8	1,556	2 07	2.36
Diamond 37	2	133	2.05	2.17
R. P. 8	2	247	2.00	2.17
B. 208	3	183	1.94	2.28
D. 145	11	2,345	1.84	2.36
*Mixed	13	6,832	1.78	2.70
D. 625	26	35,298	1.67	2.84
Bourbon	3	253	1.67	2.20

*D. 625 mixed with Bourbon and other seedlings.

Owing to the severe drought and to difficulties in securing a fair supply of labour, many of the smaller plantations had not been able to keep up their cultivation as they would otherwise have done, with the result that their crops were short. It is desirable to record separately the results supplied by the managers of the larger and hence more favourably situated plantations. The results were :—

	PLANTATIONS		TONS SUGAR PER ACRE	
	No. Reporting	Areas reported in acres	Mean	Maximum
B. H. 10 (12)	3	166	2.26	2.54
D. 118	8	1,556	2.C7	2 36
B. 208	3	183	1.94	2.28
D. 625	18	30,979	1.89	2.84
D. 145	11	2,345	1.84	2.36

The results of large scale field trials with other varieties on the sugar plantations are shown in the following table :—

Variety	Acreage	Yield
Diamond 10	32	3.67
Diamond 581	27	3.11
D. 109	78	2.10
Ba. 6032	48	2 10
D. 167	35	2.03
D. 199	15	1.74
Green Transparent	14	1 69
P. L. 2	87	1.25

KOKERIT FRUITS FROM BRITISH GUIANA.

In a report published in this *Bulletin* (1916, **14**, 8) an account was given of an investigation at the Imperial Institute of the pericarp oil, the kernel oil and the kernel meal obtained from a sample of kokerit (or cokerite) fruits sent from British Guiana. The fruits were identified at the Royal Botanic Gardens, Kew, as those of a species of *Maximiliana*, possibly *M. regia*. The Conservator of Forests, British Guiana, has recently informed the Imperial Institute that the fruits examined in 1916 were obtained from palms growing in the Botanic Gardens at Georgetown. As there was some doubt as to the botanical identity of the palms from which these fruits had been collected it was considered desirable to send further specimens for investigation, and these were received at the Imperial Institute in September, 1926. They had been obtained from the forests bordering the Berbice river and about 50 to 60 miles from the coast, and consisted of about 1 cwt. of whole fruits and a quantity of nuts which had been collected from the ground under the palms, and from which the pericarp had been eaten off by animals. In forwarding the samples the Conservator of Forests stated that one whole bunch of the fruits weighed 115 lb., of which 88 lb. consisted of fruits and the remainder of bracts, etc.

Specimens of these fruits were also submitted to the Royal Botanic Gardens, Kew, for identification. The Imperial Institute is informed that although the palm appears to be one which is grown in Botanic Gardens under the name of *Maximiliana regia*, there is some doubt as to its exact identity and that the authorities at Kew are endeavouring to procure type specimens with a view to deciding the question.

The material received last year was as follows :—

Fruits.—These consisted of pale to dark brown fruits in a moist condition. They were pointed at the apex and rounded at the base, 2 to 2¼ in. long and ¾ to 1 in. in diameter at the widest part; the base was covered

with thin papery perianth segments. The fruits were identical in appearance with those previously received.

Each fruit consisted of pericarp, nut and kernels. The pericarp was tough and fibrous externally, but the inner portion was soft and oily. The nuts were pale brown, 1¼ to 1¾ in. long and ¾ to 1 in. in diameter at the widest part. They had a very hard, thick, woody shell enclosing from one to three kernels, but usually two. The kernels were long, narrow, oval and flattened. They were from 0·8 to 1·2 in. long and 0·4 to 0·5 in. broad at the widest part. The interior of the kernel was nearly white and resembled that of palm kernels in consistency.

Nuts.—This sample consisted of nuts similar to those described above. A small amount of the pericarp remained attached to the shell.

The fruits were submitted to detailed examination with the following results.

	Grams
Average weight of a fruit	12·0
Average weight of a nut	8·7
Average weight of a kernel	1·1
Average composition of a fruit :	
	Per cent.
Perianth segments	10·4
Pericarp	17·4
Shell of nut	56·9
Kernel	15·3
Average composition of the nut :	
Shell	78·8
Kernel	21·2

Examination of Pericarp

The pericarp contained 20 per cent. of moisture and on extraction with light petroleum yield 10.1 per cent. of oil, corresponding to a yield of 12.6 per cent. from the moisture-free material, and to 1·8 per cent. from the whole fruits. The oil thus obtained was a dark reddish-orange liquid which had an odour resembling that of palm oil (the pericarp oil of the fruit of the African oil palm) and on standing deposited a large quantity of stearins.

The oil was examined with the following results, which are shown in comparison with those previously obtained at the Imperial Institute for the oil from the pericarp and with those recorded for palm oil.

—	Kokerit pericarp oil: Present sample.	Kokerit pericarp oil: Previous sample.	Palm oil.
Specific gravity at 100/15° C.	0.8590	—	0·859–0·862
Refractive index at 40° C.	1.4575	—	1·4531–1·4559
Solidifying point of fatty acids °C.	23·8	25·5	43–45
Acid value	70·1	28·6	20–160
Saponification value	206·9	211·6	198–200
Iodine value (Hübl. 17 hrs.) *per cent.*	56·1	51·4	52–57
Unsaponifiable matter *per cent.*	2·3	—	—
Soluble volatile acids[1]	0·55	—	0·86–1·87
Insoluble volatile acids[1]	2·65	—	—

[1] *cc. of N/10 KOH required to neutralise the acids from 5 grams of oil.*

Examination of Kernels

The kernels contained 18·7 per cent. of moisture, and on extraction with light petroleum yielded 54·6 per cent. of oil, corresponding to yield of 67·2 per cent. from the moisture-free kernels, and to 11·6 per cent. from the nuts or 8·4 per cent. from the whole fruits. This oil was

—	Kokerit kernel oil: Present sample.	Kokerit kernel oil: Previous sample.	Kokerit kernel oil: Bolton and Hewer.	Palm kernel oil.
Specific gravity at 100/15° C.	0·8673	0·867	—	0.873
Melting point ° C.	28·2	27·0	26·0	21–24[1] 26–29[2]
Refractive index at 40°C	1·450	—	1·4513	1·4495–1·4710
Solidifying point of fatty acids ° C.	25·5	24·2	—	20–25·5
Acid value	2·6	3·1	1·0	5–22
Saponification value	248·5	253·0	240·19	245–248
Iodine value (Hübl. 17 hrs.) *per cent.*	10·5	13·0	16·56	14–17·5
Unsaponifiable matter *per cent.*	0·3	0·3	—	below 0·5
Soluble volatile acids[3]	6·5	3·0	—	5–7·6
Insoluble volatile acids[3]	11·6	7·0	—	10–12

[1] *Open tube method.*
[2] *Complete fusion.*
[3] *cc. of N/10 KOH required to neutralise the acids from 5 grams of fat.*

a cream-coloured, fairly hard fat with an odour resembling that of coconut and palm kernel oils.

The oil was examined with the results shown on page 3, which are shown in comparison with those previously obtained for the kernel oil at the Imperial Institute, with those obtained by Bolton and Hewer for kokerit kernel oil (*Analyst*, 1917, **42**, 35), and with those recorded for palm kernel oil.

Examination of Residual Meal From Kernels

The meal left after the extraction of the kernels with light petroleum was pale pinkish-white and almost devoid of taste and odour. The results of the chemical examination are given in the following table together with the corresponding figures for the earlier sample of kokerit kernel meal, and with those for palm kernel cake. For convenience of comparison the results are calculated for cake containing 7 per cent. of fat, the average amount present in commercial feeding cakes.

—	Kokerit kernel meal.		Typical (English-made) palm kernel cakes examined at the Imperial Institute.	
	Present sample.	Previous sample.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	13.2	8.6	9·5	10·8
Crude proteins	16·1	15.0	18·0	17·3
Fat	7·0	7·0	7·0	7·0
Carbohydrates, etc. (by difference	48·6	52·5	51·3	51·9
Crude fibre	10·3	12·6	10·2	9·6
Ash	4·8	4.3	4·0	3·4
Nutrient ratio	1 : 4·0	1 : 4·4	1 : 3·7	1 : 3·9
Food units	106	108	114	113

The meal was found to be free from alkaloids and cyanogenetic glucosides.

General Remarks

In appearance and composition the present kokerit fruits resembled those received previously but were slightly larger. The pericarp contained rather less oil, viz., 12·6 per cent. as compared with 17·1 per cent., calculated in each case on the moisture-free material. The oil extracted

from the pericarp resembled that obtained in the previous case and gave similar results on examination.

The kernels of the present sample contained rather more oil than those of the earlier sample, viz., 67·2 per cent. as compared with 64·1 per cent., calculated on the moisture-free material. The oil closely resembled that from the kernels of the previous sample both in appearance and constants except that the amount of soluble and insoluble volatile acids was rather higher.

The composition of the residual meal closely resembled that obtained in the previous investigation.

In view of the similarity in appearance and composition of the present kokerit fruits to those received previously, there can be little doubt that they were derived from the same species of palm.

The pericarp oil from kokerit fruits resembles palm oil in appearence and analytical constants, with the exception of the solidifying point of the fatty acids, which is much higher in the case of palm oil. The high acid value of the oil from the present sample was no doubt due to the fruits having been shipped in a moist condition. This pericarp oil, if available in commercial quantities, would probably realise a price somewhat below that of ordinary palm oil, which is quoted at £35 10s. per ton, spot, Liverpool (March, 1927). In view, however, of the comparatively low percentage of oil in the pericarp it seems doubtful whether its extraction on a commercial scale would be remunerative.

The kokerit kernel oil closely resembles palm kernel oil both in appearance and in chemical constants and should be readily saleable in this country as an edible fat at a price approximating to that of palm kernel oil, which is quoted in Liverpool at £37 10s. to £38 per ton (March, 1927). As the kernels form only a small percentage of the fruits and nuts (15·3 per cent. of the former and 21·2 per cent. of the latter) it would be necessary to separate the kernels in British Guiana in order to reduce the cost of transport. If the kernels could be delivered whole and in an undamaged condition they would probably realise about the same price as palm kernels, which are quoted

in Liverpool at £19 10s. per ton, spot (March, 1927). Some difficulty may be experienced in separating the kernels whole from the nuts as they are easily broken on cracking the very hard shell. It seems possible, however, that the operation could be facilitated by submitting the nuts to steam heat (as is now done in the case of palm nuts to cause the kernels to shrink away from the shells) and then cracking them in a suitable machine. If the kernels could not be shipped in a whole and undamaged condition it would be necessary for them to be crushed in British Guiana.

The residual meal from the kernels is slightly inferior to palm kernel cake as a feeding stuff, and would probably realise a somewhat lower price than the latter which is quoted in liverpool at £7.10. per ton. If the kernels were crushed in British Guiana it would probably not be profitable to export the cake to the United Kingdom, but a local market might perhaps be found for it.

THE LARGE BLACK PIG.

By E. Walford-Lloyd.

It is not only in England that Large Blacks are popular, for they have been found to be the ideal pig in many hot climates, being less subject to atavism. In nearly every pig-breeding country of the world one now finds the breed well established. In Spain they are well known, and they are equally well known in Portugal. Italy, too, has an appreciable number of Large Black herds, while in Holland are to be found some keen supporters.

In British East Africa, Large Blacks are in great favour, not only for keeping pure, but for crossing on Berkshires; but as more knowledge of the pig industry is being gained in that country, breeders are there more inclined to stop cross-breeding and to keep the breeds pure.

Of late years Peru has shown a great interest in pedigree stock, especially sheep and pigs, and the Peruvian

Government have started a pure-bred herd of Large Black pigs at their Experimental School with a view to showing Peruvian farmers that the Large Black is the utility pig for that climate. Brazil is also keenly interested in Large Blacks, and there should be a great future for the breed.

The secret of making pig-breeding pay now-a-days is early maturity, enabling the breeder to get them off his hands at the earliest possible moment. To this must be added prolificacy, for sows giving only three or four pigs at a litter cannot possibly pay their way.

As regards fecundity, the Large Black sow is preeminent. She can produce a big litter, and being possessed of deep milking abilities, she makes an excellent mother, rearing her pigs with uniform success and doing them well; while at the same time she is most docile with them.

Perhaps the greater majority of herds of Large Blacks are kept on the open-air system, and where this is carried out and where sows and litters have free access to grass or woodland runs, the pigs look, and are, much the healthiest and best; and those who have the greatest experience in breeding Large Blacks consider that the more pigs have a free range, the better they do, with the exception of fattening pigs, which, of course, are best shut up for the last six to eight weeks of their lives.

The outdoor, hardy, grazing pig is the economical pig to keep; and as grazers, Large Blacks are unsurpassed for being docile and quiet, it is not half as much trouble to keep Large Blacks within bounds as it is with some other breeds. Whether it be out on the pastures in sunshine, or folded on kale and catch crops generally, in muddy weather, heavy rain, or even snow, the Large Black will continue to flourish, a fact that indeed is a practical testimony to its grand constitution.

Large Black breeders are firmly convinced that there less shrinkage between live and dead weight in their breed than in any others; and as a proof of this it may be quoted that in a well known herd over a long period of years, the shrinkage from live to dead weight has averaged only 20 per cent. and even been lower.

The meat of the Large Blacks is in no way coarse and the pork, while not too fat is of good flavour. As bacon pigs they turn out the three qualities known to the trade as "lean sizeable," "medium" and "fat," while they are eminently suitable for the production of Wiltshire bacon.

A well-known breeder of Large Blacks has given his opinion that, provided a suitable ration has been fed, the average Large Black gilt or sow is capable of carrying on her pigs in a healthy, thriving condition until they are ten or twelve weeks old. As Large Blacks are very fast growing pigs, they should be carefully fed with nourishing food at the age of from 14 to 18 weeks, for it is then that their physical needs may have outstripped their appetite, thus making it necessary to choose the rations carefully. This same breeder has also stated that the Large Black sow, on account of her great qualities, is often expected to do too much on too little, but like any good-doing breed, they pay well for generous treatment. If a herd of this breed is run on sound and economic lines, Large Blacks of good strain, well fed, are practically always fit to go to the butcher after weaning,

The British Climate is noted for its variable weather, and, therefore, it is of the greatest importance that the farmer should obtain a pig which can withstand long spells of cold and damp. In the Large Black he possesses just that pig, for they can be kept out of doors in all weather, provided only that they have a dry bed to sleep on at night. It must not be imagined, however, that the breed can exist upon grass and nothing else, for although a Large Black gilt or sow can make excellent use of rough food, yet, being prolific and a heavy milking animal, it must be fed well before the birth of the litter and also after the arrival of the small pigs to keep up the supply of milk and to prevent the sow being worn down

THE GRASSLAND CONFERENCE AT CAMBRIDGE.

A. B. Bruce, M.A., Dip. Agric. (Cantab.)

Reprinted from the Journal of the Ministry of Agriculture.—Vol. XXXIV. No. 3.

THE Ministry of Agriculture made a happy choice in selecting grassland as the subject of its third conference of Agricultural organizers. Grassland husbandry is of great topical interest—in view of the unchecked decline in arable land which recent statistics show, it could not well be otherwise—and it is a fortunate coincidence that, as Professor T. B. Wood pointed out, scientists are now entitled to present a philosophy of grass husbandry. That is to say, recent discoveries at Cambridge and, we must add, at the Rowett Institute at Aberdeen, as well as a Aberystwyth, justify scientists in giving precise scientific reasons upon which a definite rationale of the economic treatment of grassland can be based.

The Conference was attended by upwards of one hundred persons—agricultural organizers, teachers, research workers and practical agriculturists. The proceedings opened with a dinner at Gonville and Caius College on April 7, at which the Minister delivered an address dealing with the administrative and financial outlook of agricultural education and research. On behalf of the University and College authorities, Professor Buckland, President of the College, replied in a witty speech. The health of the Minister was proposed by the senior county organizer present, Mr. T. Hacking, of Leicestershire.

It is not proposed to give here a complete account of the proceedings during the following days. It will be sufficient to present a reasoned summary and to indicate a few of the significant features of the interesting contributions made to the discussions that followed the reading of the papers.

The Rôle of Mineral Substances in Nutrition.

On the forenoon of April 8 the Conference had the privilege of having for its chairman Sir F. Gowland Hopkins, F.R.S., whose world-wide reputation as a pioneer in the domain of bio-chemistry needs no emphasis here. A discussion on the rôle of mineral substances in nutrition was opened by Dr. J. B. Orr, Director of the Rowett Institute. He reviewed the present position of knowledge on the subject, including some account of recent discoveries made at Aberdeen. Up to quite recent years, the science of animal nutrition has been wholly concerned with what may be termed the grosser requirements of the animal in respect of the energy and repair balances as measured by its needs in proteins, carbohydrates and fats. The speaker, while emphasizing the continuing importance of these requirements —especially of the protein fraction—pointed out that the presence of definite, though small, quantities of "ash" substances are indispensable for the activation of the protein and carbohydrate constituents. Their absence or lack of balance may be the cause of malnutrition and the proximate reason, therefore, of disease, and that, in its turn, must react on the economic assimilation of the grosser body-building constituents.

As a guide to the absolute as well as the relative proportions in which mineral substances are needed for the health and working of the animal economy, Dr. Orr drew attention to the composition of the milk of animals in which the farmer is interested. The facts of evolution require that the food of the herbivores should show a close relation to the constitution of their natural food, that is, herbage; and as an index of the food requirements of any species, milk—the natural food of the young of that species—is the best index. When we study the natural food of herbivores, we at once recognize that natural conditions permit of a free range, whereas domestication for the purposes of man inevitably leads, if not to complete at least to a partial restriction of choice of diet. The importance of this consideration is brought home to us, also, when we consider two classes of inter-related facts which recent observation and experiment have brought to light.

First, actual analysis of herbage has shown that the mineral contents of natural grass vary from locality to locality; and, secondly, that the instincts of wild animals can be correlated with the presence or absence of certain minerals in the food they choose. Thus the migratory instinct, by force of which herbivores change their grazing grounds, can generally be correlated with mineral requirements. Again, depraved appetite (now known as *pica*), such as the eating of excreta and carrion, has been shown to be due to the absence of particular minerals in the ordinary diet. Of the latter, perhaps the most striking instance can be given from the investigations of Theiler in South Africa. Cattle pasturing in the veldt were found to be suffering from a fatal disease due directly to the eating of carrion. Theiler has shown that this depraved appetite is due to the deficiency of phosphorus in the herbage of the veldt, and that the addition of phosphates to the diet immediately abrogates the eating of carrion. More recently, Dr. Orr has shown that the progressive debility of the sheep stock in the Falkland Islands is due to the deficiency of lime in the pasturage there. Again, in New Zealand, there are regions in which an iron deficiency is found, accompanied by the prevalence of certain ailments in the grazing stock.

Generally speaking, scientists are now justified in stating (1) that a deficiency of minerals (whether it be the definite absence of one or more, or whether it be an *unbalanced condition of all*) leads to malnutrition, and (2) that a state of even minor malnutrition is followed by a predisposition to disease, sometimes definitely infectious, sometimes purely functional. Thus a deficiency in *lime* produces sterility; various forms of weakness of limbs and joints; rickets and roughness of coat; a deficiency of *phosphorus* causes stiffness of joints, lack of co-ordination of movements; lack of both lime and phosphorus seems to predispose to tuberculosis; deficiency of *iron* causes anæmia and low vitality of young; and deficiency of *iodine* leads also to loss of vitality, and in human beings to goitre.

To return to the significance of the mineral content of milk. The "ash" composition of cow's milk compares with that of pasture grass as follows* :—

	Calcium.	Phosphorus.	Chlorine.	Sodium.
Ash of Cow's milk	1·7	1·5	1·4	·6
Ash of pasture grass (not hay)				
Good ...	2·6	1·2	3·5	·7
Poor ...	1·5	1·1	2·2	1·1

These facts emphasize two conclusions : (*a*) that good pasture (that is, natural pasture as improved by the skilled agriculturists) is a perfect food for young herbivores—cattle and sheep ; (*b*) even poor (unimproved) pasture approximates in composition to milk.

Finally, Dr. Orr stressed a most significant fact. Under modern conditions, fatting cattle and milch cows are fed on large quantities of plant by-products. Cakes and meals are vegetable substances less nitrogenous and oily matter. These are all, also, more or less deficient in natural minerals ; there is consequently a mineral drain on the animal body, which, in the case of milch cows depletes the store of minerals in the bones. Further, ultimately there is a mineral drain on the soil. Unfortunately, in the present state of knowledge, this drain cannot be definitely corrected, either by direct additions to the soil or by supplementing animal foods by definite "mineral mixtures." Again, it must be borne in mind that this drain is not merely absolute ; it may be relative : the balance of mineral substances may be as important as the absolute amounts, and excess of certain mineral constituents may be as dangerous as deficiency.

In the discussion on Dr. Orr's paper, many facts confirmatory of his views were elicited, of which perhaps the most significant was the observation made by Mr. Hay, of Somerset, that in some cases he had observed that the incidence of tuberculosis in cows could be correlated with a lime deficiency in the soil. It may also be re-

* These figures compare the content of quantities of equal feeding value of milk and grass respectively.

corded that Mr. Boutflour, whose experience of cow rationing is very wide, finds that a mineral addition to cow rations often gives satisfactory results.

In closing the discussion, Sir F. Gowland Hopkins wittily suggested that, as the last man who had taken an interest in a grass diet died so long ago, it was difficult for him, a student of human nutrition, to take an active part in the subject of the Conference! He thought, however, that what had been said pointed to the importance of a conclusion to which his own researches had long been directed, namely, the supreme importance of small factors causing malnutrition and, ultimately, predisposition to disease.

The Function Of Materials In The Animal Body.

On the afternoon of April 8, Mr. J. B. S. Haldane, Reader in Bio-chemistry, gave a lecture on the function of minerals in the animal body. Of the experiments by which the lecture was illustrated, the most striking was a demonstration of the influence of a solution of mineral substances on the beating of a heart separated from the body of a rabbit. It was shown that a solution approximately of the same composition as sea water maintained pulsation indefinitely, while the omission from the solution of a single ingredient led to a cessation. Another striking demonstration was the action of minerals in relation to the proper functioning of such enzymes as ptyalin, the active principle of saliva. It was shown also that minerals generally are required for the activation of proteins, the free ions of the former determining the physical conditions (solution, etc.) of the latter. Coming to the specific action of inorganic substances generally, it is known that, apart from those present in the bones, they constitute less than one per cent. of the animal body, and of these, calcium, phosphorus, potassium, sodium and magnesium bulk more largely than other necessary constituents such as iron, iodine, zinc and fluorine.

The Composition and Nutritive Value of Young Grass.

On April 9, the forenoon was occupied by an account given by Dr. Woodman of his recent researches on the composition and nutritive value of young grass, that is, grass in a condition before the formation of flowering stems, with its accompaniment of lignification, has set in. Briefly, the methods employed were the cutting of the grass with a lawn mower at weekly intervals, the drying of the produce, its analysis and the carrying out of digestion experiments with sheep. For purposes of comparison, plots were hayed and periodical cuts of the aftermath were taken. The experiments covered the seasons of 1925 and 1926 and were conducted both on light and heavy land. Figures were obtained showing by weekly intervals the total weight of fodder produced, its chemical composition, and the actual digestibility of the several constituents. Dr. Woodman put before the Conference a number of tables of relevant figures, accompanied by remarkably vigorous and lucid explanations and illustrations. The whole was of extreme value, furnishing as it did an example of careful scientific reasoning, surrounded, as all such reasoning must be, by the limitations which the conditions of the experiments necessarily impose. There is no feature more characteristic of modern research work than the essentially provisional nature of all scientific hypotheses, and the care that is taken to avoid the dogmatic certainty which so often characterizes the utterance of the non-scientific man.

The principal conclusions reached by Dr. Woodman may be stated briefly as follows :—

(1) The produce of closely grazed pasture has a higher feeding value than has hitherto been believed : the *dry matter* of young grass (not exceeding 3 to 4 in. high) may be characterized as a concentrated food of high protein content and remarkable digestibility ; it contains, moreover, adequate amounts of vitamins and of minerals such as lime and phosphorus. These characteristics persist during the whole grazing season from April to October.

Thus it was found, in two seasons and on soils of contrasted character, that the *dry matter* of closely mown pastures, in April to June, contained from 21 to 27 per cent. of crude protein, whereas the corresponding figure for hay (cut June 25) was 9 per cent. In July the figure was, for pasture, 21-25, and for aftermath 18-23 per cent., and for weekly aftermath cuts in July-October the figures were 23-29 per cent. of crude protein.

Next as regards digestibility : The protein of pasture showed 77-85 per cent. digestibility, whereas the protein of hay showed only 56 per cent.

Next, the starch equivalents of the produce *per acre* over the whole season may be contrasted : From pasture cuts 2,300 lb., containing 680 lb. digestible protein ; and from hay and aftermath cuts 2,450 lb., containing 430 lb. digestible protein. In regard to these figures, it should be noted that although when measured in terms of starch equivalent the produce in each case is much the same, the pasture cuts contain 50 per cent. more digestible protein.

Finally, the digestibility of the dry matter of pasture grass and that of the moisture-free content of an average sample of a feeding-cake may be contrasted.

Digestible Protein Per cent.		*Starch equivalent per cent.*	
Pasture	*Cake*	*Pasture*	*Cake*
22	19-27	74	52-84

Digestibility of Organic Matter per cent.

Pasture	*Cake*
84	58-80

(2) Under ordinary farming conditions the dry matter of good pasture grass, *whatever its botanical composition*, retains the characteristics of a highly nutritious concentrate all through the grazing season, provided that it is kept closely grazed. Where the pasture is sparse and "poor," close grazing and the use of fertilizers to ensure density of herbage should be able to overcome any difficulty arising from inferior botanical composition.

This conclusion is justified by the following facts. The botanical composition of the two pastures under experiment differed widely; nevertheless, the analyses and feeding trials gave much the same results. Further, the botanical composition of each plot changed in the same season under treatment with no sensible effect on the results.

(3) A ration purely of young grass is unbalanced; it is too rich in protein and too deficient in carbohydrates. It should be supplemented by a carbohydrate concentrate such as a cereal grain.

This conclusion follows from a consideration of the figures given above.

The discussion which followed this paper was confined to a consideration of the bearing of the work on practical farming; that it will be profound, particularly on existing methods of management of grassland, was agreed by all the speakers. The extension of Mr. Woodman's investigations will be awaited with interest.

Sectional Grazing Plus Nitrogenous Manuring.

On the forenoon of the third day of the Conference (Sir Daniel Hall in the chair,) Mr. W. Brunton gave an account of his trial of the Hohenheim system of sectional grazing coupled with nitrogenous manuring. The system in question was fully described in an article published in the issue of this Journal for September last, p. 498. Briefly it consists in stimulating the continuous growth of herbage by repeated applications of a nitrogenous manure (in this case sulphate of ammonia) and the rapid grazing down of the young produce followed by periods of 20-30 days' rest during which (if necessary) a further application of manure is made. Contrary to what has been taught and believed for a generation, this treatment has no evil effects on the quality of the herbage; no mat is produced and—an unexpected feature—the growth of wild white clover is stimulated.

Mr. Brunton's experiment related to 27 acres of pasture land, a large part of which was originally of poor quality and set aside for grazing by horses. The whole

area was divided into seven paddocks by means of rough four-wire fences. the two upper wires being barbed. Arrangements were also made whereby a pipe supply of water was available for the stock in each paddock. The trial has occupied two seasons—1925 and 1926. In the autumn of 19 4, the whole area was treated with lime (15 cwt.), superphosphate (5 cwt.), and kainit (4 cwt.), followed by an application of sulphate of ammonia at the rate of 1 cwt. per acre. Further dressings of the last mentioned manure were made during both summers amounting in all in some cases, to 4 cwt. per annum. The total cost of the fencing, manuring, etc., was at the rate of £4 6s. per acre. The results obtained in 1926 on the 27 acres were briefly as follows :—

MARCH 15. Grazing started with 30 ewes and 40 lambs.

April 8. Milch cows replaced sheep.

October 10. Cows removed.

OCTOBER 23--December 31. 120 lambs at grass.

Total pasture days (stock carried multiplied by days of grazing), 8,555.

Average number of cows pastured 46, or 1·75 per acre.

The procedure was to stock the paddock at the rate of 10-12 cows per acre for 5 days ; then to allow rests of 20-30 days, during each of which, if necessary, as judged by the growth of herbage, a dressing of sulphate of ammonia was given at the rate of 1 cwt. per acre.

Mr. Brunton is of opinion that, provided care and intelligence are exercised, the system is a sound business proposition. It provides a longer grazing period (note the early commencement and the late close) ; gives a great saving in the cost of concentrated food (no less than £164 in this case) ; enables more stock to be carried per acre ; and leads to a great improvement in the amount and character of the herbage.

Mr. Brunton's conclusions were confirmed by the results obtained at Reaseheath Farm Institute, Cheshire, of which some account was given by Mr. Carr, Agricultural Organizer for the County.

The discussion which followed Mr. Brunton's address went to emphasize his view that a requisite of the new system is, above all, intelligent management. A point which requires study is the extent to which the system can be applied to ordinary farming; it was generally agreed that under ordinary conditions only a fraction of the grassland of a farm can be treated intensively—a considerable area must be kept for hay and rough grazing—and what this proportion should be remains in doubt. It should be noted, too, that so far no experience with fatting stock is available.

As a result of the enterprise of Messrs. Nitram, Mr. Brunton's experiment is being repeated at some 30 centres in the country. It is interesting to note that the remarkable results obtained confirm Dr. Woodman's work on the high feeding value of young grass.

In the afternoon the Conference listened to an interesting address by Mr. J. G. Stewart, in which a great many problems of grass husbandry were discussed. Mr. Stewart stressed the economic importance of providing winter keep, expressing a hope that plant breeders would give more attention to the practicability of either introducing or breeding a variety of grass endowed with the capacity of growing at low temperatures. A description was given of the experiments being conducted at Hohenheim, to which Mr. Stewart made a visit last summer. Among the notable features there was the luxuriant growth of perennial rye grass and white clover, and the fact that, although the treatment had been followed for ten years, no signs of deterioration were visible.

In the discussion which followed, Professor Stapledon made a valuable suggestion based upon what he had seen in New Zealand, namely, that it should be possible to practise sectional grazing without the necessity of providing special fencing. Mr. Carr of Cheshire, gave the result of some observations he had made on the evil effects of small dressings of sulphate of ammonia on grassland. Mr. Bond, of Derbyshire, contributed an interesting speculation on the possible action of nitrogen on a dead mat of grass, in a manner similar to that observed by Hutchinson

and Richards in connexion with the rotting of straw. In closing the discussion, Sir Daniel Hall suggested that the Hohenheim method would best be applied to second-class pasture.

Results of Grasslands Trial Plots.

On the fourth day of the Conference (Mr. R. M. Wilson in the chair) Dr. Hanley, of Bristol University, read a paper summarizing the results obtained on the plots laid down in pursuance of the Ministry's grassland "campaign" initiated in 1919, and giving the deductions he had made as a result of his visits to these experiments. These reached the remarkable total of 700 in all, situated in 50 different counties. Dr. Hanley presented a classification of poor pastures, indicating in each case suitable means of improvement. In regard to these, his experience led him to doubt the value of indicator plants, such as Calluna, as a guide to treatment. The peats often presented an insoluble problem; downland, on the contrary, was the easiest of all to treat. Broadly speaking in most cases either a complete manure, or phosphates followed by lime, gave the best results, but it was most important in all cases to observe that the full effect of mineral manures is shown under pasture conditions only. It is futile to measure results by taking a crop of hay. Except in the presence of a mat, the use of phosphates was generally successful, high solubility doing better than low. Dr. Hanley was strongly of opinion that further experiments in the use of phosphates in dry conditions, as well as in methods of improved management, were needed, but, on the whole, the grassland campaign had been productive of very useful results.

Grassland Botany.

On the forenoon of April 12, the closing day of the Conference, Professor R. G. Stapledon (Professor Scott Watson in the chair) read a widely ranging paper on grassland problems, considered mainly from a botanical standpoint, and illustrated by an interesting series of graphs, embodying the results of the researches of the Welsh Plant Breeding Station.

At the outset, the lecturer stressed the importance of two considerations: the effect of the nature of the herbrge on stock, and the no less important consideration, the effect of the stock on the herbage. He showed a number of useful seasonal produce graphs of various species, demonstrating that the problem of maintaining a more or less constant supply of produce was dependent on securing some mixture of species. For winter keep, he placed Italian rye-grass in the forefront. Generally speaking, a species had to be considered from many aspects, of which its productiveness, persistence and aggressiveness were the most important. The differences of mineral content should also be observed, coltsfoot, for example, being specially rich in phosphates. All round, the clovers were better mineral carriers than the grasses. Incidentally, the high mineral content of rape was emphasized. Professor Stapledon expressed some doubt as to the ability of certain pastures to withstand such a defoliation as a prolonged period of close grazing might entail. He also stressed the usefulness of temporary leys in providing abundance of keep at seasons when it is most needed.

Perhaps the most striking of the valuable series of figures presented by the lecturer was one correlating the laboratory germination percentage with the actual plant population resulting from the same seed. The figures showed conclusively that there is very little correlation between laboratory figures of germination and the actual proportion of plants finally established, the latter depending largely on variety. Great importance was attached to the proper arrangement of grassland, such as the optimum number of animals grazed and the duration of grazing. Belief was expressed in a system under which grass fields should be used both for hay and pasture in the same season.

In relation to grass mixtures, Professor Stapledon advocated a prescription involving a few species each of a suitable strain specially chosen to suit the particular soil and the particular style of farming pursued.

National Aspects Of Grassland Husbandry.

The last address of the series was given by Professor T. B. Wood (Professor Sir R. H. Biffen in the chair), and was devoted to a consideration of the national aspects of grass husbandry as they were likely to be modified to suit new conditions, such as (1) the progressive increase in the area of grass, and (2) the new knowledge now available. He showed that the bulk of the grassland was now producing a "coarse fodder" suitable for maintenance rather than for production. The new knowledge suggested that much of the existing grassland could be utilized for production purposes. What was needed was simply close grazing coupled with better management in the matters of stocking and manuring. On a consideration of the economics of the problem, it would appear that the head of stock carried under ordinary conditions would not be sufficient to eat down the grass in the flush season, and that, consequently, in view of Woodman's results, the surplus produce should be mown, and, if practicable, used (in a dry state) as a concentrated feeding stuff at seasons when growth was less active. Professor Wood presented calculations which showed that, in grazing inferior pasture, animals consumed a considerable portion of the available energy merely in walking about to find an adequate supply of food. As regards the system of sectional grazing advocated earlier in the Conference, it was suggested that farmers generally would have difficulty in putting up the capital needed.

In conclusion, Professor Wood, summing up the trend of the whole conference, suggested that scientists have now a philosophy of grassland husbandry to offer to practical men. Hitherto grass had been treated almost as a jungle product, which needed no special management and might be left to the mercy of nature. Scientific attention had in the past been concentrated on arable husbandry and comparatively little research had been done in the productivity of grassland. As a result of the converging attack of the botanist, nutrition chemist and physiologist, many new facts had come to light, the summing up of which

should enable the husbandman to make a reasoned attack on what seemed to be likely to become the agricultural problem of the age—how to make the best use of our ever-increasing grasslands. At the close of his address, Professor Wood created great interest by distributing samples of a grass "cake" made under his direction from closely mown grass, subsequently dried in a malt house and then compressed into an adherent mass. Feeding experiments with this cake are about to be instituted with material to be supplied by Messrs. Nitram Ltd.

Finally, some reference to a domestic side of the Conference should be made. The arrangements for the housing of the members were excellent and directed by Mr. P. G. Dallinger, the Ministry's Chief Inspector of Education. He, in his turn, feels that acknowledgments are due to Professor Wood and the Master and Fellows of Gonville and Caius College for the comfort which all attending the Conference enjoyed throughout the meeting.

PREVALENCE OF "ROUP" IN FOWLS AND CHICKENS.

Its Detection and Treatment.

By Samuel Bruce, M.V.D.
Acting Government Veterinary Surgeon.

The mention of the term "Roup" usually brings to mind the complex diseased group variously known as chicken-pox, canker or diphtheria, etc. More recently it has been associated with disturbance in nutrition and as a result there exists some confusion as to the significance of the term. Perhaps if we adopt the view that many of the more extensive searchers into poultry disease now hold we will simplify matters. Let us apply "Roup" to describe a

condition manifested as a "cold in the head" or a catarrhal rhinitis. At any rate confine it to the upper air passages and adjacent sinuses. As such it may be primary or secondary. Thus it may arise from cold, and infection of a non-specific nature just as in other species.

Predisposing factors are overcrowding, poor ventilation and climatic conditions.

Secondarily, we may expect it to be associated with a number of ailments, more particularly fowl-diphtheria, pneumonia, fowl-cholera, and disturbance in nutrition. We have an analogous situation in the horse with influenza and glanders, in the dog with distemper and in the hog with cholera.

In other words, roup is a symptom just as rhinitis (cold in head) often is and not a clinical entity in every case.

It is characterized by a sticky discharge from the nostrils which dries and plugs up the openings, thus causing the latter formed discharge to back up and penetrate the nasal openings. There it accumulates, dries and becomes cheesy in nature (a common thing in birds is for pus to become cheesy or caseous), causing bulging below the eyes and even evolvement of the same. All cases may not go to this extreme but attention is here called to this possibility to show how exactly we may be misled into calling all such cases canker or fowl-diphtheria and considering them to be due to a specific infection. The condition may be complicated with pneumonia and terminate fatally. There is usually a falling off or suspension of egg production, loss of appetite and ruffled feathers. It may be difficult in many cases, to differentiate this condition from canker, but we will try to limit the application of the term to the more benign disease of the nose and adjacent sinuses. Should symptoms such as described above have associated with them pox, lesions on the comb and wattle, we would then unhesitatingly rule out the diagnosis of simple roup. Young chicks fed from the time of hatching or shortly thereafter on a ration lacking in vitamines, such as a ration

of corn, bran etc., will, in from two to six weeks show symptoms of "leg weakness," loss of appetite, anœmic condition of the comb and wattles, drooping wings, ruffled feathers and frequently inflammation of the eyes. At first there is a thin viscid discharge which may glue the eyelids together, then the formation of a tightly, adherent, white membranous film, and finally the collection in the conjunctival sac of white, cheesy exudate. This eye affection is the most characteristic symptom of the deficiency disease and because of the resemblance to the formerly so called "roup," it is best diagnosed by necropsy. Birds affected shows a severe involvement of the kidney. This organ appears pale and marked with the network of very fine white lines, which are tubules filled with urates. The ureters become as large as a lead pencil. These white deposits of urates are found on the liver, heart and other organs. Pustule-like lesions, of the size of a pin-head, are found on the mucous membrane of the mouth, pharynx and aesophagus very much as we find in canker (fowl-diphtheria). Also we occasionally find white cheesy material in the cleft and mouth. In fowl diphtheria the caseous material is yellow in colour.

Treatmemt—For simple roup (cold in the head) swab out nostrils and cleft, with a pledget of cotton, then immerse the head in a warm one and a half per cent. solution of creolin, or any coal tar product for a few seconds. If one wants to take a little more pains, insert this solution or a few drops of tincture of iodine through the nostrils with an eye dropper or syringe, holding the mouth open to allow the fluid to escape. This should be done twice daily until discharge ceases, Make an incision into the bulging sinuses and squeeze out the mass, then treat antiseptically; preventive measures will naturally suggest themselves when we consider the cause.

Avoid draughts, exposure, etc: correct improper housing conditions. As a precautionary measure all sick birds should be isolated. There are no biological agents of any value in this condition. Nutritional roup may be readily cured if not too far advanced by the administering of cod

liver oil and allowing access to plenty of green food. The latter measure will usually prevent the appearance of the disease. Roup associated with fowl diphtheria (canker) is a formidable proposition. Isolation is imperative.

Badly infected birds are best dealt with by destroying. Mildly affected cases can be handled as suggested under simple roup. Direct attention to preventive measures. Ventilation has been tried abroad with conflicting results.

EXPERIMENTS IN ROTARY TILLAGE.

Experiments into the principles of rotary tillage have up to date been fruitful more in suggestions for further research rather than in convincing evidence vindicating the method. We say this in no disparagement of rotary tillage but more with the object of showing the need there is for the subject to be studied *au fond*. That this need should exist to-day is passing strange, since rotary tillage has been with us for several years now and many agricultural authorities, scientists, soil physicists and others are fairly well agreed that this form of cultivation will some day supersede the plough. But what is hindering the supersession at this juncture ? If rotary tillage is so much more to be preferred, if it presents the ultimate criterion by which all cultivation methods will be judged, if it is so advantageous from a labour-saving standpoint, why does it not make greater headway with farmers to-day ? That is a most pertinent point. Admittedly prejudice has an arresting effect on so novel a way of performing many operations with the minimum of effort and time, but prejudice can be swept away by educational investigation. That is why it is urgently necessary for some authority to undertake a complete inquiry into the position. We were assured last year that a certain institution was to conduct such an investigation, but pressure of other work and more

important duties have apparently caused that plan to miscarry. Meanwhile the main problems remain unsolved. Inquiries of a type are made here and there. We referred to one in the last issue of THE REVIEW, but the author of that examination was the first to describe it, in effect, as somewhat inconclusive. We have details of another inquiry which has been made in Vienna. In this case the rotary cultivation gave by far the richer crops compared with the controlled plot, but the test contains the fundamental weakness, to our mind, that the whole area, control and experimental, was first ploughed. This certainly vitiates the comparison between a method which is held to supersede the plough and companion tillage implements, and the older method now so generally practised. For this reason it would be unwise to dwell on the actual crop contrasts since the comparison is not a true one of two distinct forms of cultivation. Attention can be drawn, however, to one really remarkable circumstance, and this despite the fact that both areas were first ploughed. It was found that the proportion of beet to leaves on the experimental plot—for the crop grown was sugar-beet—was very dissimilar from that on the plot ploughed, cultivated and harrowed in the usual way. In other words, it was discovered that rotary tillage shifted the relation between beet and leaves very much in favour of the former, a phenomenon characteristic of air nourishment in distinction to soil nourishment, and from this it is deduced that rotary tillage, with its intensive and uniform loosening of the soil, brings about a more rapid decomposition of the humus present in the soil and perhaps of stable manure supplied than does ploughing. This question, it appears, is to be the subject of further investigation, which merely goes to confirm the timeliness of the plea we put forward for a complete and satisfying inquiry into the entire matter, particularly as it is commented in this instance also that the claim that rotary tillage does a series of operations simultaneously and effectively presents a field for much study, especially when different classes of soil are taken into account.—*The Implement and Machinery Review, Vol. 53, No. 626.*

ERRORS IN FEEDING LIVE STOCK.

By T. B. Wood, C.B.E., M.A., F.R.S., Professor of Agriculture, Cambridge University.

During the past 25 years, hundreds if not thousands, of papers have been published, many of them containing facts and observations each of which has added a little to the sum of our knowledge of the laws of nutrition of farm animals. It would, I suppose, be within the bounds of possibility to give a detailed catalogue of these individual papers, setting out the salient points of each. Such a proceeding would take a very considerable time, and would be quite useless to the farmer, although valuable to the investigator. Indeed, every investigator before he starts his investigation makes such a catalogue in his special line of work, either on paper or in his own mind, in order that he may experiment in the light of other people's results.

I myself have read many of the papers on nutrition published during the last 25 years, and what I propose to set out is the general impression of the practical value of nutrition research which their perusal has left on my mind. It will of necessity be a personal impression—another writer might stress different points—but I hope it will be useful to the practical man, as it has been to me, not only in the conduct of my own research work but in the rationing of the animals on my own farm.

Traditional Methods are Wrong.

My first impression, and I do not think this particular point is open to argument, is that the great majority of owners of live stock who feed their animals on traditional lines, are wrong in the following particulars :—

(1) They include too much protein in the rations of their fattening animals.

(2) They include too much protein in the ration of their working animals.

(3) They do not give enough protein to their young growing animals.
(4) They do not give enough protein to their milking animals.
(5) They do not give enough ash constituents of the right kind to their growing animals and their milking animals.

Points 4 and 5 are, however, not within the province of this article. They have been dealt with already by Mr. Mackintosh, of Reading, Dr. Orr, of Aberdeen, and Dr. Crowther, of Harper Adams College; consequeutly, I do not propose to discuss them further. The remainder of this article will be devoted to discussing points 1, 2 and 3.

Protein For Fattening Animals.

The usual method of feeding fattening animals, namely, to give them roots and straw or hay, supplemented by a generous ration of oilseed cakes, has been handed down traditionally from the time when it was started at the close of days of the great landlords 70 or 80 years ago. It originated from the work of the first chemists who turned their attention to agriculture, and concluded, on grounds which have subsequently been found to be wrong, that fat could only be produced in the animal body from fat or oil and protein. Oilseed cakes, being rich in both these constiutents, seemed excellent for fattening, their use became general, and the custom has lasted.

It is about 70 years since Lawes and Gilbert showed that most of the fat formed in the body of a fattening animal was formed from carbohydrates, such as starch and sugar; but this observation, although accepted by physiologists, is only just beginning to find its way into agricultural practice as the result of more recent research.

Recent accurate research on this subject dates from Kellner's measurements of the fat-producing power of proteins, oils and carbohydrates, which showed that proteins were distincty less effective fat-producers than either of the other recognised constitutents of feeding stuffs. Still more recent work has shown that full grown animals

required much smaller amounts of protein than most rations provide, and that increased supplies of protein in the case of such animals do not raise the rate of live-weight increase.

The amount of digestible protein required by full-grown animals on full fattening rations is well known. It is, for a full-grown or approximately full-grown steer, not more than 1½ ℔. of digestible protein per day ; for a full-grown sheep not more than 1¾ ℔. of digestible protein per week. These quantities are usually greatly exceeded. The excess does no harm to cattle, except, of course, that its provision entails wasteful expense. In the case of sheep, an excessive supply of protein is apt to cause death through failure of the kidneys.

Protein for Woking Animals.

As with fattening stock, so with working animals, the traditional idea is that protein is the source of muscular energy. This is not true, and there is no need to increase the protein in the ration of an animal because it is required to do hard work. It is unfortunate, however, that no important additions to our knowledge of the protein requirements of the horse have been made in recent years.

Protein for Young Animals.

It is desirable that a young animal should grow, and consequently that it should increase in weight. The food requirements of the growing animal are to a very large extent governed by this fact, since they must not only keep the animal alive but must provide the material of which the increased weight is composed. In recent years much work has been done on this subject, the gist of which is that the increase in live weight made by a young animal consists mainly of water, but contains considerable quantities of protein and ash. It is noteworthy that a young, rapidly growing animal usually puts on very little fat.

Protein being the most abundant constitutent of the live weight increase of young animals (of course excepting water), it follows that a young animal requires a liberal

supply of protein in its ration. Traditional practice does not give this, especially in the case of cattle. As a rule, young stock are wintered on poor pasture with perhaps a little poor hay or in yards on poor hay or even straw and a few roots. They would do very much better and so would their owner, if they got some of the cake which is so often wasted on fattening cattle and sheep. This fact is beginning to meet with some measure of recognition, especially in the production of "baby" beef fat lambs and pigs which are ready for the factory at six or seven months old.

COMPUTING RATIONS.

My next point is that the knowledge which has accumulated as the result of the research work carried out during the last 25 years makes it possible to compute a ration which will produce any desired result within the posibility of the animal which is to consume it.

For some time past, advanced milk producers have adopted the method of basing their rations on the principle of maintenance ration *plus* an additional allowance per gallon of milk. In much the same way it is possible to compute rations for young growing animals or for fattening animals on the basis of maintenance ration *plus* an addition for each pound of live weight increase which it is desired to produce.

The essential points of rationing on this system are :—(1) That an animal's appetite is limited—a full-grown steer, for instance, will not eat more than about 25 to 30 ℔. of food per day, weight in the dry state.(2) That a large part of this food is required simply to keep it alive—this is the maintenance ration—and its amount, measured by modern experiments, is given in the books referred to above. To this maintenance ration must be added so much real nutritive value per ℔. of increase expected.

The more increase one expects, the more real nutritive value it is necessaay to get into the limit of the animal's appetite ; which means using highly digestible foods such as cakes, corn, meals and roots for the productive part of the ration. For young growing animals

requiring much protein, a good proportion of cake is desirable. For adult fattening animals, corn, meal, and roots are cheaper and more suitable.

Starch Equivalent.

It is usual to measure the real nutritive value of feeding stuffs in terms of their starch equivalent as determined by the method of Kellner. The weight of starch equivalent required to produce 1 ℔. of increase in animals of various classes has been found from the results of research modern on the composition of the carcases of animals. This method of computing rations is a distinct advance on the methods hitherto in use. When it gets absorbed into the general practice of farming it will correct the common errors in feeding noted above, and will add materially to economy in animal production.—*The. Farmer and Stock-breeder and Agricultural Gazette No 1889.*

THE ROOTS OF SUGAR-CANES.

Their Distribution in Soil.

In the new American Journal, *Plant Physiology* (Vol I. No. 4.) Dr. Atherton Lee publishes a very interesting account of his work on the distribution of sugar-cane roots in the soil.

The method used is ingenious yet simple, and gives results which are quantitative. It consists in collecting and weighing roots present in consecutive soil strata, each of thickness eight inches. Five representative stools of cane are selected and the stems cut down level with the surface of the soil. Stakes and boards are erected so as to enclose the area occupied by the plants. Excavations are then commenced within the rectangular space. The soil of the first eight inches is removed by a spade, and thrown on to a one-quarter-inch-mesh sieve. Care is taken to cut

the soil as close to the stools as possible, so that it contains all the roots that occupy the first eight inches depth of soil. The roots are then separated by screening through the sieve, washed, dried and weighed. The next eight-inch layer of the soil and roots is similarly excavated, and its root content determined by screening and weighing. The process is repeated for each eight-inch stratum down to the forty inches level. By these means precise numerical *data* are recorded.

CONCLUSIONS.

1. The majority of the roots of sugar-cane grown in Hawaiian soils under Hawaiian conditions, occur in the uppermost levels of the soil. In the case of canes grown *in furrows*, more than 58 per cent. of the roots occur above the 8-inch level. In the case of canes grown *on ridges* (hilled-up canes), the largest proportion of roots occur between the 8-inch and the 16-inch levels, measured from the base of the stool, In either case, only 15 per cent. or less of the roots occur below the 24-inch level.

2. Irrigation water will reach more roots in the case of canes grown in furrows than in the case of canes grown on ridges.

3. Cane varieties liable to root disease, or canes grown without irrigation, will obtain more root aeration if grown on ridges than if grown in furrows. The roots of canes suffering from lack of aeration seem to exhibit a black colour due to the absence of numerous secondary feeding roots, and to the rotting of the cortex tissue, which leaves the stele uncovered. On the other hand, healthy, aerated roots exhibit a light-brown colour, are well supplied with feeding roots, and possess intact cortex tissue.

4. Deep tillage preparatory to planting, and the incorporation of organic matter into the deeper soil strata should encourage aeration, should stimulate the formation of secondary feeding-roots, and should minimize root-rots.

5. Calculations from weights recorded in these studies indicate that between 0·9 and 1·85 ton of dry organic matter is left as cane-rooots in the soil by a crop of some 8,500 stools of cane per acre, grown under irrigation in Hawaii.

VISIT OF KEW BOTANIST.

Mr. H. C. Sampson, C.I.E., Economic Botanist at present attached to the scientific staff at Kew, England, where he is engaged mainly on investigations connected with the disposal and marketing of tropical agricultural products, arrived in the Colony on July 31. Since then he has been busily engaged in visiting the various agricultural centres, comprising trips to the North Western District, Pomeroon, Essequibo, Berbice, Corentyne, and other points of interest including several sugar estates. He has also been in touch with some of the commercial houses in Georgetown who handle agricultural produce.

In consultation with His Excellency the Governor who has, from the beginning, taken very great interest in the matter, the Director of Science and Agriculture has arranged Mr. Sampson's programme and is accompanying him on excursions as often as his administrative duties will permit.

His wide experience of agricultural conditions in India and Africa makes Mr. Sampson a particularly valuable officer at Kew when matters relating to agricultural policies in the tropics come up for consideration. Kew has been helpful in the past to the Carribean Colonies in the introduction of useful plants and in other ways; the policy of sending a qualified officer to gather first-hand information on conditions is striking evidence of the new progressive policy recently inaugurated in connection with agricultural development in the Colonies.

British Guiana is grateful for this visit, made possible through the Empire Marketing Board which is making a contribution to Kew for the maintenance of this and similar services involving visits periodically to outlying parts of the Empire.

J. S. D.

FOREST DESTRUCTION AND ITS EFFECTS.

THE question of the action of forests on rainfall has been debated by foresters, agriculturists, engineers, and others for a long period, the discussion probably dating back to the time at which scientific forest conservancy was first introduced. In the tropical and sub-tropical parts of the world this is not, however, the point of primary importance. The vital factor for the community at large is the determination of how far the destruction of forests in catchment areas and on the sides of hills and mountains in the drier parts of a country, affects in the first place, the level of the water in the big rivers, a matter of extreme importance when the rivers are utilised for irrigation or power works; secondly, the decrease in the local water-supplies and in local precipitations upon which the cultivator is dependent, and, thirdly, erosion and avalanches, and the destruction they cause in the fertile valleys beneath, Sudden floods may also cause enormous damage to railways, towns, and so forth. In India, which was the first part of the British Empire to give consideration to this aspect of the forest question, the matter has been the subject of discussion and reports through the whole of the past century, a statement which will perhaps come as a surprise to many in Great Britain.

The problem of affording protection to forests for the above causes alone is by no means new. In France and Germany special laws for the protection and extension of the forests and the protection of agricultural lands by means of the forest have long been in operation; and similar laws exist in the Italian States. So far back as 1475, the subject attracted the attention of the famous Venetian Council of X., by whom a law was passed on January 7 of that year, regulating in great detail the clearance of the forests *terra firma*. The mountain forests especially were protected by judicious regulations, which were renewed from time to time down to the very year of the extinction of the old republics. Tuscany and the Pontificial Governments were equally provident.

History has since shown that the wholesale destruction of forests in Spain, Italy, Sicily, Greece, and Macedonia has resulted in a great deterioration of climate over considerable tracts, due to loss of moisture, the sterilisation of the soil, and excessive erosion. Although now well known, the chief action of the forest may be stated briefly as follows: The great factor in mountainous and hilly country is the maintenance of tree growth on parts of the area. In the case of bare slopes the rain rushes rapidly down, causing erosion, only a fraction percolating into the soil, and is carried rapidly away, giving rise to spates and perhaps to serious floods since the old channels of these streams or rivers are no longer able to carry the excess water of flood levels. A hot sun bursting out on to the slope after the rain quickly dries up the thin layer of moisture covering it. In the hotter parts of the globe subject to heavy rainstorms or monsoons, the rushing water starts gullies which eventually become ravines, all surface soil is rapidly washed away, and in the course of years the hillside is eaten into, rubble and boulders being sent down to cover up valuable lands below. When the area is under trees, a portion of the rain, falling on the crowns, drips slowly, down on to the layer of humus beneath and sinks into it. The larger portion perhaps, falls direct on to the forest floor, where it is gradually absorbed in the soft covering which takes it up as a sponge. The water then percolates slowly downwards, filling up springs and underground reservoirs, and reaches the streams in a retarded manner. The flow in the latter is consequently more even and regulated as also the amount of water which eventually reaches the rivers. The latter can therefore be more depended upon to maintain a normal level when it ts required to utilise them for irrigation or power works. The roots of trees protect the surface by holding up the soil, and thus directly prevent denudation.

It is possible to give some concrete examples of the effects of the destruction of teak forests in India during the first half of last century, owing to the large demands for this timber from rapidly expanding markets.

The slopes on the west coast of the Bombay Presidency were once, even in the early days of British occupation, covered with magnificent, valuable, and extensive, teak forests. These have long since been cut out, some disappearing for good. The denudation of the Deccan Highlands and the Eastern Ghats has resulted in excessive erosion and the gradual silting up of the rivers. When the Dutch, French, and English first built settlements on the Coromandel Coast, it was possible to take ships up the Godaveri and Kistna. The English port of Narasapur and the French one of Yunaon, both on the Godaveri, were once the chief ports on this coast. They can now be reached only at high tide by small native shallow-draught craft. Last year the present writer had arranged to go down the Godaveri from Sironcha, on the frontier of South Chanada (Central Provinces) and the Hyderabad State, to Rajamundri, as he wished to carry out investigations in connexion with the effects of forest denudation on this river. It was early in March, the commencement of the hot weather season only. Inquiries elicited the fact that few rafts were now going down, owing to the extensive sandbanks already drying off in the river, and that even by dugout canoes, delays from stranding on sandbanks would be inevitable. Some hundred years ago this great river was the chief artery or high road into the interior. At Masulipatam, Dutch ships used to ride at anchor close up to the port, whereas at the present day even small native vessels have to anchor five miles out in the roads owing to the silting up. Between 1840 and 1850, Dr. Gibson, the first Conservator of Forests in Bombay, drew up a list of the rivers and creeks on the Malabar coast, where on arrival in those parts ships used to ride at anchor, all the creeks having silted up within the memory of men then alive.

Dr. Cleghorn, who afterwards became the first Conservator of Forests in Madras, directed attention to the destruction of tropical forests at the meeting of the British Association in Edinburgh in 1850. A committee was appointed to consider this matter. Dr. Cleghorn submitted its report, which was confined to India, the only country for which information was available, at the meeting of the

Association at Ipswich the following year. The report summarised the position, as then known to the few in India who had given attention to the matter, pointing to the great and uncontrolled destruction which was taking place, both at the hands of timber merchants and owing to the careless habits of the native populations, who grazed their cattle at will in the forests and fired them every year in order to encourage the growth of new grass. The indigenous tribes in the hilly country also practised unchecked shifting cultivation, a practice second only to the lumberer in the destruction of fine forests. Under this method, which was a common habit in Europe in olden times, a patch of good forest is felled and the material burnt *in situ* ; coarse grains are then sown on the clearing. The cultivator then sits down and awaits the harvest. Two or three crops are taken off the area ; the weeds then become too strong (as he never troubles to weed) and he moves on to a fresh area. The enormous destruction of virgin forest this practice entails, when practised for centuries, has to be seen to be credited. Yet many of the tropical and sub-tropical forests in British Colonies and Dependencies are still subject to this the most pernicious and precarious form of so-called agriculture (as also to over-grazing and firing), the administrations responsible not having yet, appearently, understood the evils which attend it. The difficulties facing these Governments in prohibiting the practice or controlling it were all experienced in India, in one form or another, and overcome. The encouragement given to the growth of tea and coffee and similar crops by British administrations in the Empire, whilst eminently praiseworthy if carried out on well-considered lines, has been productive of great harm in the past, and even the present day can scarcely be said to be free from anxiety on this score. In a report written in India in 1876 with reference to coffee planting, the following criticism is made :

"The planters who come over from Ceylon are now giving a very high price for land, and the whole mischief may be effected in a very short time. It must not be supposed that coffee is at all a permanent cultivation ; we have only to look at the Sampajee Ghat in Coorg, the Sispara

Ghat in the Nilgiris, and parts of the Annamalais to see at once that it is very often very little better than the shifting cultivation of the natives. It pays a coffee planter to take up a tract of primeval moist forest on our mountain slopes for a few years; he gets bumper crops the third, fourth and fifth years, but denudation of the soil and erosion goes on rapidly, and it does not pay him to keep it up many years."

Two other examples may be mentioned. In Ajmere-Merwara in Rajputana, all the waste and forest land was handed over to the people by Government in 1850. The hills were rapidly denuded of timber and grazing was uncontrolled. The crops are irrigated from tanks (ponds) formed by building embankments across ravines. Some of these were very old. The rainfall is scanty and comes in heavy showers. The water, rushing down in torrents, quickly eroded the denuded hillsides, the tanks filled up with silt and debris or the embankments burst. In 1869, at the end of a two-year famine, the region was described as follows: "The cattle had perished, the people had fled, large villages were entirely deserted and the country was almost depopulated." All this was due to the mistaken policy of giving to the people what they had clamoured for, the uncontrolled use of the forest lands. An even more classic example is that of the well-known Hosiarpur *Chos* in the Punjab. The hills were formerly fairly well wooded. A rapid increase in population followed the advent of British administration in 1846. The consumption of forest produce augmented, the herds of grazing cattle multiplied excessively, and complete denudation ensued. This was followed by erosion, broad stretches of sand invading the plains beneath, with the result that the arable lands of 940 once prosperous villages were covered with sand, which laid waste upwards of 70,000 acres of fertile lands. In 1900 this formerly rich district was traversed by numerous broad, parallel, sandy belts cut out of the crop-bearing and fertile area.

In India these matters are now well understood, and the Forest Department, supported by the Government, has control of the great forest areas. Proofs of the disadvan-

tages and disasters following the uncontrolled wasteful utilisation of the forests in mountainous and hilly country are not therefore wanting. It is known that the same processes are at work, and the same mistakes are being made, in our Colonies. It it the habit of British administrations to work in water-tight compartments. Probably the major portion of the difficulties being experienced in different parts of the Empire have been solved, or are approaching solution, in one or other of the provinces in India. They present no new features, as some appear to think, as the above-quoted examples go to prove. The chief difficulty is that action is delayed until almost irretrievable damage has been done and then the forester is asked to reafforest the areas so denuded. This entails an enormous expenditure, great skill, with success ever hanging in the balance.

Attention was directed to this subject at the meeting of the British Association in Edinburgh in 1920, when a paper dealing with the Indian forests was read. Resolutions of the same kind were also passed by the World's Forestry Congress held in Rome in May, 1926. As an outcome of last year's meeting of the British Association at Oxford, the Chairman of the Forestry Sub-Section, Lord Clinton; drew up for the Council a brief statement dealing with the destruction of forests on the hill slopes, with special reference to the tropical forests of the Empire. This memorandum has been submitted to the Secretary of State for the Colonies, by whom it is being communicated to the Colonies and Protectorates. It may be hoped, therefore, that the chief factors of destruction, namely, shifting cultivation, excessive grazing and the firing of forest lands, may receive that measure of considered control which the expert forestry services under the Colonial Office are fully capable of inaugurating if supported by the several administrations.—*Nature*, Vol. CXIX, No. 2,984.

LAND SETTLEMENT.

The following important communication was made to members of the Jamaica Agricultural Loan Societies Board by Mr. Archibald Spooner, a member of that Board, and also a member of the Board of Management of the Jamaica Agriculture Society.—Editor.

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One of the important points in this connection is that the Agricultural Loan Societies Board has got the organisation to deal with the question of land settlement through the agency of loan banks, and acts for the Government in this matter, whilst no other Government Department has any special organisation for this purpose.

The Banks are formed by the people, owned by the people, and run by the people. If they succeed, the people benefit; if they fail both the people and the Government are the losers. As far as I know, no serious criticism has ever been levelled against the system of land settlement associated with loan banks, and as far as the government is concerned it has, as security for money that it advances, the whole of the assets of the banks. If land be available for land settlement and the people want it, all they have to do is to incorporate themselves into an association called a Loan Bank, and agree to purchase so many shares in this Bank. Upon such agreement if the scheme looks a good one to the Agricultural Loan Societies Board, the Government can lend two-thirds of the face value of the shares agreed to be purchased, which sum will largely form the working capital of the Bank. The Bank can then apply for more money to purchase land for land settlement, and if the scheme is approved by the Government, the Legislative Council can be asked to vote this, and then the land will be in the hands of the people for such sub-division as they may decide upon, and to be sold out at such prices as they may decide upon. They will be left alone to manage their own affairs without interference from anyone so long as the interest of the Government is fully respected and not jeopardised, and every assistance

will be given so far without any charge, by the trained officers of the Agricultural Loan Societies Board, so as to make the whole thing a success. If in spite of such assistance the people, or their officers chosen by them, show inability to manage their affairs, thereby jeopardising their own, and the Government's money, then the Agricultural Societies Loan Board can and does, appoint a capable manager to set the concern on its legs again, after which it will be handed back to the people. If the scheme appears to be a hopeless failure, the Agricultural Loan Societies Board has power to appoint a liquidator who can recover as much as can be recovered of the debts due to the Government.

The system, on the whole has proved a success, and been a powerful agent for the education, uplift and improvement of the people, bringing to the fore talented men like the late Hon. and Rev. A. A. Barclay and others, and entrusting the people with responsibility to each other, and to the Government Land settlement without financial assistance from a land bank would almost inevitably mean that the settlers would have to borrow from money-lenders at impossible rates of interest. The Banks may, perhaps, charge what may seem high rates of interest on certain loans, but these are ever so much lower than those of the independent money-lender: however, whatever rates may be charged by a Bank, these rates are settled by the officers of the bank chosen by the people, perhaps they could be lowered, if the people as a whole had a higher moral sense in meeting their financial obligations. However, the banks do not pay extravagant dividends; if I remember right a higher dividend than 10 per cent. is not allowed except by permission of the Agricultural Societies Loan Board and this would be on the paid-up share capital only.

Where mistakes have been made in the past they have been due to buying land at inflated prices or too large an acreage of land, in excess of the requirements of the people of the district, or land not very favourable for the profitable production of crops, or land that has become attacked with Panama Disease. The last land settlement scheme, Daly Grove, in Manchester, has been safeguarded by requiring the bank formed in connection with the scheme,

to pay down a proportion of the land purchase money, the Government finding the rest, and this has been done in a district as hard to make a living in, as any part of the island. In another district, and not a rich one, Stewart Town, a Land Bank has bought an estate for settlement and settled for it without any assistance from the Government.

Personally, I am against land being acquired by the Government and plotted out amongst the people, and the matter ending there unless, of course, the people buy and pay for the land at once. If not, the people would be sure to fall into the hands of money-lenders to whom they could not even give a first lien on the land and the Government might find itself forced to resume possession of small pieces of land, perhaps indefinitely for default in purchase instalments. A Loan Bank has the machinery for dealing with this kind of thing, the Government has not.

It would be a different matter if there were a State Agricultural Bank having local branches capable of dealing with matters of local agricultural finance, and the purchase and sale of land for settlement in various parts of the island. Unless this comes, I think we should make the best of the Loan Banks and run the Land Settlement schemes in connection with them and so raise up a self-reliant and self-helping people not dependent on the Government to do for them what they can do ever so much better for themselves.—*Journal of the Jamaica Agricultural Society Vol. XXXI. No. 7.*

THE CELOTEX INDUSTRY

It is reported that the Celotex Company will, within the next two years invest four and a half million dollars more in its Marrero plant, across the river from New Orleans and will concentrate its manufacturing of Celotex in Louisiana, so far as the western Hemisphere is concerned. This will bring the total investment in the plant up to $10,000,000. This improvement will consist of the installation of four additional machines at intervals of six months which will result in the doubling of the present mill capacity. Additional baling plants will also be installed throughout the sugar belt far securing the bagasse, where there are already twenty six balers in operation. It is stated that the Celotex Company already consumes 75 per cent. of the bagasse manufactured in Louisiana. This development is an interesting one, especially to anyone who remembers back to the time when the bagasse was taken from the Louisiana factories and dumped into the river to get rid of it, or, on those places not located on the river, taken to specially built furnaces where it was burned, not as fuel, but simply to destroy it. Then came the day when bagasse furnished a large part of the fuel on the sugar plantations with the improved furnaces that provided for burning the moist material, and now comes its abandonment as a fuel and its manufacture into a building board that has the reputation of being an excellent insulating board and is in great demand.

Mr. H. B. Strait, Australian representative of the Celotex Company of America, has just been in Queensland in connection with the industry. It is claimed that there is enough sugar cane in North Queensland to manufacture 600 million square feet of Celotex a year. A mill is to be established in the center of the country of the north, for which capital has been subscribed. Mr. Strait expresses himself as very pleased with his reception in Australia. His present misson is to create a demand for Celotex. It is being placed on the market and is being used in the town

hall in Brisbane, now being erected at a cost of $4,500,000. Mr. Strait mentioned the progress of the industry in America, where five years ago, 12 million feet were manufactured, whereas last year the total was 200 millions, and this year it will be 350 millions.

There is no doubt that if the industry is successful it will solve many of the building problems of the tropics in Australia, where galvanized iron is most used at present owing to its easy working. Iron is, however, very unsuitable for a hot climate, and makes the lot of women in particular very trying. The authorities on life in the tropics have been urging the use of other material than iron for dwellings.—*The Planter and Sugar Manufacturer*

SUGAR INDUSTRY OF PORTO RICO.

The following is abstracted from an address delivered by Mr. G. A. Jones at a General Meeting of the Trinidad Agricultural Society on June 9th. 1927. Mr. Jones visited Porto Rico last year at the same time as Mr. Wm. Nowell, whom he accompanied over the Island. It is felt that his remarks will be of interest to our sugar planters.—Editor.

The sugar industry of Porto Rico has gone up by leaps and bounds during the last 25 years; from 150,000 tons to 650,000 tons. This increased tonnage coincides with the period of occupation by the U.S. of America and is due entirely to this cause. The three largest factories, producing between them one-third of the Island's sugar output are American owned and controlled.

Porto Rico grown sugar is admitted free of duty to the United States, an advantage of $36 per ton. It was generally agreed that without this preference Porto Rico would not be able to produce sugar in competition with Cuba and other countries.

A commission of investigation recently appointed by the Governor of Porto Rico reports the cost of production in competitive countries in 1922 as follows:

Cuba................2.14c. per lb.
Hawaii..............4.01c. per lb.
Porto Rico..........4.04c. per lb.
Louisiana...........4.85c. per lb.
Beet Sugar (U.S.) 5.02c. per lb.

The enormous preference that Porto Rico thus enjoys has brought prosperity to her sugar industry and has stimulated the adoption of better Agricultural methods.

An enormous amount of capital has been expended on immigration projects both public and private. This is particularly so in the South of the island where the largest Centrals are situated. (Guanica 100,000 tons, Aguirre 60,000 tons, Mercedita 23,000 tons). The rainfall in this section of the island is very low, about 20 ins. per annum, they are therefore almost entirely dependent on irrigation.

One scheme laid down in 1908 cost the Government $5,000,000 and irrigates 333,000 acres, another more recent one irrigates 12,000 acres at a cost of $3,200,000.

The tax for public irrigation is $15 per acre per annum—a reasonable insurance against drought.

Hydroelectric power is often developed in connection with irrigation systems.

The conditions on these irrigated estates are so different from ours in Trinidad that little will be gained by comparisons. The soils are rich, deep, black alluvials.

In the Northern district the soils are not so fertile as those of the South Coast Estates, and they do not depend to the same extent on irrigation, but some irrigation is practised on most of these estates to supplement the rainfall. Here again the soils are mainly deep alluvial.

It is in the North-Eastern section of Porto Rico—in the Fajardo district that we found conditions approximating those of the Naparimas. Several of the Fajardo Estates are undulating and at least one could be termed hilly. The Fajardo soils are termed 'heavy' but we saw nothing

approaching our heavy soils anywhere in Porto Rico. This important factor must be continually borne in mind when comparing conditions and practices in Porto Rico and Trinidad respectively.

CULTIVATION PRIOR TO PLANTING.—

The most thorough preparation is given the soil before planting. The general practice is to plough the lands with a Fowler outfit of which one or more sets may be found on all estates of any size. After a fallowing period of one or two months the land is cross-ploughed two or even three times with a harrowing in between. The second and subsequent ploughing is usually done with ploughs drawn by "Fordson," "Oil Pull" or "Holt" tractors and very frequently by cattle drawn ploughs.

This thorough cultivation is in strong contrast with our cruder methods of drilling, etc., but the difference is largely due to varying soil conditions. During our visit in September, one of the wet months, all these ploughs ranging from a Fowler outfit to cattle ploughs, were at work practically every day, and within a day or two of a fall of one or two inches of rain the soil was quite workable.

However, the point is that if these soils require so much working up, then our much heavier ones require more. When we give one ploughing we regard it as something of a luxury, whereas these soils are being constantly turned up.

DRAINAGE AND FORMATION OF BEDS.

The question of drainage and formation of beds is tackled in a totally different manner in Porto Rico as compared with Trinidad and is one of the first things that attracts attention. Instead of having deep drains every 20, 25 or 30 feet, their fields consist of a series of 9 or 10 feet wide ridges, each ridge having two rows of cane. On either side of the two rows of cane a shallow drain, sometimes made entirely with a double mould-board plough, and in heavier soils finished with a spade leads to a cross-drain dug a little deeper and situated every 40, 50 or 100 feet, apart, the distance of these depending on the nature of the soil.

This practice is almost universal throughout the non-irrigated sections of Porto Rico. In this way they do away with the necessity for deep drains and subsequent ploughing and cultivation is made very much easier.

Whether this system would work with our soils is a matter for experiment but it is well worth a trial.

The ridging and the draining is usually done with cattle-drawn ploughs and in making the ridges, two cuts are first made with the single mould-board plough, one each way, before the mould-board plough is used. This lightens the final work of ridging considerably.

It might be conveniently mentioned here that cattle-ploughing has been developed into quite a fine art in Porto Rico. Every native handles a plough most skilfully and on the steepest lands. The most popular hill-side-plough for cattle ploughing is one made by the Weird Plow Company, and is a one way plough.

The best ploughing I have ever seen in the West Indies was at Aguirre, where men were ridging with a cattle-drawn double mould-board plough, following the contour of a slightly rising ground most perfectly.

Cane Seed and Planting Distance.

I find the general tendency is to plant more and more seed per acre. Mr. McConny, the Field Superintendent of Fajardo—a most successful planter—though brought up in the Barbados School of wide spacing is an absolute convert to the "ample seed" doctrine.

The usual practice on good lands even in irrigated districts is to space the rows 4½ ft. apart and on poor hill-sides the planting distance was 4 feet.

When cane holes are made—a practice that is now dying out—three and four plants are put to the hole. When the planting is done in furrows we found several methods in vogue: (a) a continuous planting with long

cane covering the seed with a hoe or sometimes with a plough ; (b) continuous planting with a row and half thus :—

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(c) double plants one foot apart as at Mercedita :—

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. 1ft. . . . .

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The aim is to have a good stand of cane from the outset and to cut out supplying as much as possible. By this method it is also claimed that far more cane of a uniform, mature age is obtained as they have not to depend so much on suckering latter on. Furthermore the land covers in very much quicker reducing weeding and soil washing.

There is evidently room for experimenting in this direction. One of the obvious objections is the far greater amount of seed required per acre, but in Porto Rico they think nothing of using 3—4 tons of seed per acre provided they get a good spring which they regard as all important.

Pen Manuring and Fertilizers.

One of the most remarkable things we met with was the complete absence of pen manuring as an agricultural practice in Porto Rico. On no estate visited was this practised. There is s complete absence of pens and the animals are all grazed in the pastures and the manure lost. They maintain that the operation is too costly under Porto Rican conditions of expensive labour. The remarkable thing is that they are able to carry on without it and get highly satisfactory yields per acre as the following will show.—

Estates I.—Irrigated, Crop 1925.

Wet season plants 60 tons per acre.

Crop Plants—40 tons per acre.

1st Ratoons—32 tons per acre.

Estate II.—Non-irrigated, Crop 1926.

Area as wet season plants, 1,580 acres yielded 41.8 tons per acre.

Crop Plants 632 acres, yielded 36.1 tons per acre.

1st Ratoons, 2,250 acres, yielded 26.7 tons per acre.

2nd Ratoons, 2,499 acres yielded 41.8 tons per acre.

3rd Ratoons, 791 acres, yielded 20.0 tons per acre.

Other Ratoons, 249 acres, yielded 21.04 tons per acre.

An average return over 8,400 acres or 27.79 tons per acre.

One estate had an estimated crop of 40 tons all round for this year. On the other hand most liberal dressings of artificial manures are made, and it is claimed by one and all that this heavy manuring pays and pays well. The following figures give some indications of the amounts used :—

Estate 1.

Plant canes—800-1,000 lb. of artificial manure containing 12 per cent. N., 6 per cent. Phos., and 5 per cent. Potash.

Ratoons —800lb. of same manure.

Manure applied in two applications.

2. Same mixture but not quite so heavy an application.

3. 600lb. of the same mixture.
4. 400 lb. of the same formula at 1st weeding and 200 lb. of Sulphate of Ammonia 6 weeks later.
5. 800 lb. of same formula in two applications.
6. Use 128 lb. Nitrogen per acre.

The cost of this artificial manure is about $44.70 per ton.

They have no positive evidence that phosphates and potash are required and some estates such as Aguirre are using nitrogen alone. Some of the most progressive estates regard an application of 3 lb. nitrogen per ton of cane as a safe basis to calculate on.

Artificial manure is always buried.

Green Dressings.

We did not find green manuring a general practice; indeed it was usually claimed that green manuring did not pay. At Mercedita some cow peas were grown and later ploughed under.

Weeding.

Clean weeding was considered everywhere as an essential to successful cane cultivation. The fields are kept particularly free of weeds by numerous cheap weedings repeated at intervals of every 2 or 3 weeks. At one estate plant cane fields are given as many as 10 weedings, three units however often weed an acre per day.

Stripping of Canes.

Stripping of canes is not practised in Porto Rico.

Tractor and Ploughs in Use.

As stated above the Fowler Steam Cable outfit is to be found on most of the bigger estates and the conditions are ideal for their successful use. For second and subsequent ploughings tractors are in common use. The most popular type is the Rumely Wheel tractor known as the "Oil Pull" which is rated 20-35 H.P. and weighs 9,000 lb.

and cost $3,800. This is the only type of Oil Pull in Porto Rico, though the same firm makes a heavier type rated at 30-60 H.P. and costing $4,750.

The plough that is in common use with this tractor is the " Saunders " made by the Newell Saunders Plough Co. It is not unlike the " La Crosse " plough in general design but is even simpler in general construction and particularly so in the draw bar arrangements.

The Fordson tractor is also much in evidence and always pulling the " Oliver " No. 3 single mould-board plough.

We saw several Holt Tractors. At Cambulache they had six 5-ton tractors and six 10-ton ones. At Guanica they had several of both types. Mr. Brebnor, the Field Superintendent at Aguirre, and the " Oil Pull " representative in Ponce, were both familiar with the Holt tractors and they both expressed the opinion that the " Best 60 " is a better tractor than the Holt 10 ton. The plough in use with the Holt tractor was always the " Saunders."

It may be of interest to mention that the " Storey " rotary plough was designed by Mr. Storey at Aguirre, and I am informed that the Fowler Company are engaged in producing this type of plough. An account of the Storey plough appeared in the "Louisiana Planter," for January 23rd, 1926, p. 68.

Tile Draining.

We found two estates—Mercedita and Aguirre—experimenting with tile draining. At Mercedita a considerable area (200 acres) has already been completed and the results are so encouraging that they are extending the trial. The method adopted on this estate was to open drains about 3 feet deep, lay down 4 inch pipes cover the pipes with about 6 inches of gravel covering this again with coconut leaves, and again placing a layer of gravel on the leaves bringing the last layer of gravel up to the cultivated level, say 1½ to 2 feet from the surface.

At Aguirre they merely covered the tiles with a layer of gravel to prevent the joints from being blocked by silt.

The tiles are made of cement and sand, 7-1 mixtures and are not very costly. They have a Richmond Power Drain Tile Machine for turning out the tiles.

The advantage of tile draining is very obvious and should we decide to try a few acres it would be best to do so on our lighter black soils. I am doubtful whether tile draining will draw the water in our heavier soils, but this is a matter for experiment.

We saw no machine in use for digging the open drains.

Ratooning.

There is a considerable variation in the number of ratoon crops taken on the various estates of Porto Rico. In the Southern irrigated district we find only one ratoon being grown and in some cases not even one, one-third of area is planted in wet season plants, one-third in crop plants and one-third in 1st ratoons.

On one estate 80 per cent. of the plants are put in in the wet season and 20 per cent. in crop. About 40 per cent. of the plants are kept as first ratoons. On another, 50 per cent. in wet season plants and 50 per cent. in crop plants. First ratoons only. On yet another, no ratoons are run.

Value of Cane Lands in Porto Rico.

The reason given by the administrators of the South Coast Estates for the absence of ratooning is the high value placed on land and the high cost of irrigation. To make these estates pay, the highest possible yields per acre must be obtained and they have worked it out that this is best done by running plant canes only and occasionally a first ratoon.

Land in this neighbourhood has recently changed hands at as much as $1,000 per acre. The usual value is about $500 per acre ; no one, however, is prepared to sell at this price.

At (a) Estate a charge of $1.45 per ton of cane was made this year for rent. At "B" rent and taxes amounted to $1.50 per ton.

In another district, however, land has not this enormous value and the charge for rent and taxes last year was 79 cents per ton or $21.91 per acre.

Taxation in Porto Rico.

With the high preference given the Porto Rican sugar grower, he is in a position to pay and is made to pay very high Insular Taxation, this may amount to as much as 40c. per ton of cane.

The Use of Cattle on Porto Rican Estates.

One of the most remarkable features of Porto Rican Estate management is the use they make of cattle and the almost complete absence of mules. It is impossible to stress this point too much. Cattle are to be seen everywhere and working daily. The native Porto Rican bullock is a splendid animal and is well handled. In the first place, the cattle are yoked differently to ours, being yoked to the horns. It is claimed by several managers who have experience of working oxen in both ways, that the animals have far better control of the load when yoked to the horns and the work they do in Porto Rico seems to bear this out. I argued that cattle could not be used on undulating lands, but having spent a day riding over one of the hilly estates of the Fajardo Company where I saw cattle working on grades that we would hardly send mule carts on I had to drop the argument. They work with complete success on some of the steepest hillsides.

The saving in fodder were we able to use more oxen would be considerable. They feed no concentrates to the working cattle in Porto Rico; they live on grass and molasses. It is probably true that the grass in Porto Rico is superior to ours, but this would be overcome by our growing Elephant grass and Uba cane as fodder as they grow these grasses in addition to para and guinea grass in Porto Rico.

The Colono System.

A very considerable proportion of the canes ground at the factories is purchased from cane farmers called Colonos, These people are usually large growers owning

their own lands. They are paid on a sliding scale depending on (1) the sucrose content of the cane (each truck is sampled separately) : and (2) the price of sugar.

Advances are made to these Colonos by the factory and 9 per cent. interest is charged. The supervision of the way these advances are spent is very close.

CANE VARIETIES.

The two most popular canes in Porto Rico are the B.H. 10/12 and S.C., 12/4, and the Estates are rapidly converting their whole holdings from other varieties to these two. Of the two the former is slightly the more popular, though it is claimed by many that under certain conditions the S.C., 12/4 is superior. There has been a complete change over to these two varieties within the last few years. On 90 per cent. of their soils it would be folly to plant anything else.

On one estate on the heavier soils they have had excellent results with a variety known as D. 433. The late Sir John Harrison in a letter stated that he had no record of this cane having been produced in Demerara, so that its origin is somewhat obscure. Its sucrose content is somewhat low but on the chance of its doing well on some of our red soils I have secured a few plants. Another variety that is doing well on the same estate is F.C., 136, and they kindly gave me a few of these for trial.

On several estates we found a fair amount of interest in the P.O.J. Seedlings. With the exception of P.O.J 2725—one of the newer importations—all these P.O.J. seedlings are 100 per cent. infected with Mosaic disease, but they are such vigorous growers that they show no ill effects. This is particularly so with P.O.J. 36 and 213. For this reason I did not consider it advisable to ask for plants from these estates with the result that I was only able to obtain 20 plants of each of these varieties from the Rio Piedras Experiment Station, where they have a few disease free plants.

I was able to obtain 20 plants each of the following varieties : P.O.J. 36, 213, 234, 826, 979 and 228, D. 1135 and Tuc. 507, 510 and 439.

So far as we were able to judge the P.O.J. 2725 is immune to the Mosaic disease, and the Agricultural Director of the Mayaguez Federal Experiment Station spared me 200 plants of this most promising variety and 15 plants of P.O.J. 2771, another promising variety.

We therefore have a good start with P.O.J. 2725.

Sugar Cane Diseases in Porto Rico.

The most serious diseases is the Mosaic but they have tackled the problem with energy and success on most of the Estates. Where the disease was very bad such as at Mayaguez in the Western district they had to resort to the growing of Uba cane which is immune. By the planting of clean "seed" only and followed by careful roguing it is being got rid of from many estates. On the Estates in the Northern district we saw plenty of Mosaic even in fields of B.H. 10/12, and S.C. 12/4, recently planted, but these varieties showed little ill effect from the disease. It will be very interesting to see whether they will eventually suffer. We could see no evidence of vigorous measures being taken for its eradication.

Another disease which is causing anxiety is the gummosis. Certain varieties are very susceptible to this disease, particularly H. 109, D. 625, Ba-6032, etc. As this disease is not known in Trinidad, great care will have to be taken to prevent its introduction.

There is also an Aphis which does considerable damage to Uba cane in Porto Rico and which is not known in Trinidad. Care will have to be taken to prevent its introduction with the plants I have brought in.

To achieve complete isolation and as a measure of precaution all these varieties have been planted on Mr. Higgins' Estate at Macqueripe, where no canes are grown commercially.

Central Aguirre have engaged the services of a whole-time Entomologist to study the various insect pests which cause them considerable losses. The chief of these are the small moth borer (*Diatraea saccharalis*) and the white grub (*Lachmostema* sp.). The entomologist is mainly engaged in looking for and introducing parasites from other countries.

The same central has also joined with Central Guanica to employ a plant pathologist to study the plant diseases of the sugar cane in Porto Rico.

Liming and Lime Pulvers.

It is the general practice on estates on the North Coast to lime their soils and applications of about 2 tons of ground lime-stone per acre is made at each re-planting.

Many of the estates have a lime-stone crushing plant of their own and the following particulars are given of the one seen at Constancia :—

Name of Pulver : Jeffrey Lime Pulver.
Makers : The Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
Size : No. 3.
Capacity : 1½ tons per hour.
R.P.M. : 1,800.
Motor: 50 H.P. (25 H.P. would be sufficient.)
Size of stone : 8' x 3".
Cost installed in Porto Rico : $1,400.
The lime pulver at Aguirre was more elaborate.
The one at Fajardo has a capacity of 4 tons per hour, also made by the Jeffrey Company.

The Mayaguez Federal Experiment Station.—

We spent one afternoon going over this station with Mr. Davis, the Acting Director. Mr. Davis is a trained plant breeder and is devoting his whole time to turning out cane seedling.

The most promising seedlings we saw were crosses between P.O.J. 2725 and S.C. 12/4. These crosses showed true hybrid vigour and should produce some excellent new seedlings. It is too early as yet to judge of these canes as they are only in their first year.

The Insular Department of Agriculture is a formidable organisation with head office in San Juan. The Experiment Station is situated in Rio Piedras some 10 miles outside the town, and here they carry on their sugar cane experimental work and have their laboratories—Chemical, Entomological and Mycological.

They have a very comprehensive collection of sugar cane varieties numbering several hundreds. Each is carefully labelled.

They also carry on manurial and cultural experiments and the results are published from time to time in the form of a Bulletin.

At Mayaguez there is in addition to the Federal Agricultural Department, an Agricultural College supported by the Insular Government.

DEPARTMENTAL NOTES.

Professor J. Sydney Dash, B.S.A., late of the Imperial College of Tropical Agriculture, arrived in the Colony on July 11, and assumed his duties as Director of Science and Agriculture the following day.

Professor Dash who has had a distinguished career as an agriculturist, received his early training under Mr. J. R. Bovell, I.S.O., late Director of Agriculture, Barbados. He took his degree with first class honours at McGill University, Montreal, specializing in plant pathology. After holding several positions in Canada he returned in 1914 to Barbados to fill the post of Assistant Director of Agriculture. In 1918 he accepted the invitation of the sugar planters of Guadeloupe of the French West India Islands to visit that island and organise and direct their Experiment Station. He spent three years there and then returned to Canada to take up the position of Tobacco Specialist in the Department of Agriculture at Ottawa, investigating tobacco varieties, diseases, etc. Later he held the post of Supervising Botanist in the Seed Branch of the same Department. When the Imperial College of Tropical Agriculture was started in October 1922, he was offered and accepted the position of Professor of Agriculture. His duties entailed lecturing on a wide range of crops, with special attention to the major tropical industries. In addition he carried out important investigations, notably on sugar-cane, bananas, tobacco, cover and rotation crops generally and has contributed freely to the pages of *Tropical Agriculture*, the Journal of the Imperial College of Tropical Agriculture.

Professor Dash is greatly interested in agricultural research and has visited the more important Experiment Stations and Institutions in England, Canada and the United States of America.

A meeting of the staff was held at the head office, Broad Street, on Tuesday, July 26th at 2 p.m. The Director presided, and various items of a domestic nature affecting the Department were discussed.

The Director attended a meeting of the Georgetown Chamber of Commerce on July 22. He promised to co-operate with the Chamber in all matters which might come within the scope of his Department.

The Director visited His Excellency the Governor's ground nut cultivation on July 27. A report of the visit is given elsewhere in these columns.

The Government Economic Biologist paid a visit to the North Western District on July 19, to investigate an attack of "Cockles." A short note on his visit appears in this issue.

We are pleased to record the visit of Mr. H. C. Sampson, C.I.E., Economic Botanist at Kew, who arrived in the Colony on July 31, and to whom special reference is made on page 241 of this issue.

Meteorological Data—January—March 1927.

Recording Stations & Months.	Rain-fall. Total Inches.	NUMBER OF DAYS OF RAIN: Under ·10 Inch	·10 to ·50 Inch	·50 to 1.00 Inch	1.00 Inch to 2.00 Inches	Above 2.00 Inches	Total days.	Evaporation. Inches	Air Temperature and Humidity. Air Temp. Maximum.	Minimum.	Mean	Humidity. Mean
Botanic Gardens.												
April ...	2·76	3	5	1	1	...	10	5·12	86·2	76·0	81·1	77 9
May ...	18·57	6	11	4	5	2	28	3·83	84·7	75·9	80·3	82·9
June ...	8·34	4	14	7	...	...	25	3·09	84·5	75·5	80 0	83·8
Totals	29 67	13	30	12	6	2	63	12.04				
Means.	...	...	...	...	...	...	...	...	85·1	75·8	80·5	71.5
Berbice Gardens.												
April ...	5·37	4	5	3	1	...	13	...	88·1	74·5	81·3	77·1
May ..	15·84	3	10	7	6	...	26	...	86·3	74·7	80·5	81.6
June .	11·98	4	12	3	4	...	23	...	87·4	74·7	81·0	81·2
Totals	33 19	11	27	13	11	...	62	...				
Means.	...	...	..	...	...	...	...	.	87·3	74·6	80·9	79·9
Onderneeming.												
April ...	5·52	1	...	1	4	...	6	...	89·0	74·0	81·5	...
May ...	19·10	1	3	2	7	3	16	...	89·0	73·0	81·0	...
June ...	14·50	1	5	8	4	1	19	...	88·0	72·0	80·0	...
Totals	39·12	3	8	11	15	4	41	...				...
Means.	...	...	...	...	...	...	...	...	88·7	73·0	80·8	...
Morawhanna. N.W.D												
April ...	4·15	...	6	1	1	...	8	...	...	...	...	...
May ...	15·03	...	9	5	5	1	20	...	...	...	...	...
June ...	26·87	1	10	8	8	2	29	...	...	...	...	...
Totals ...	46·05	1	25	14	14	3	57	...	...	...	..	...

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,726
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,209
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	1,4617
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ...	5,671	1,968	1,642	2,629	1,949	2,539	1,610	18,008
1922	3,557	1,841	1,105	1,593	1,525	1,522	1,397	12,950
1923	4,038	2,780	1,595	1,934	1,953	2,137	1,951	16,388
1924 ..	4,123	2,827	1,103	1,789	1,678	2,146	1,664	15,330
1925	3,317	2,755	1,580	1,819	470	1,663	1,597	13,201
1926 * ...	1,732	2,627	1,219	2,172	364	1,268	1,600	10,982
1927 1st Qr.	414	768	346	683	266	598	598	3,673
2nd Qr.	245	174	252	409	249	327	527	2,183

* Decrease in attendances caused by very unfavourable weather conditions.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first six months of 1927

The corresponding figures for the same period during previous years and the average for the same period for nine years previous to that are added for convenience of comparison.

Product.	*Average 1916-24.*	*1925.*	*1926.*	*1927.*
Balata, cwts. ...	3,081	3,330	4,457	2,956
Cattle-food (Molascuit) tons	669	692	430	241
Cacao, cwts. ...	10	None	None	None
Cattle, head ...	219	357	11	4
Charcoal, bags ...	23,270	16,887	16,344	17,227
Citrate of Lime, cwts.	88	None	None	None
Coconuts, thousands...	1,301	608	422	101
Coconut Oil, gals. ...	12,258	14,209	12,550	10,280
Copra, cwts. ..	2,200	7,670	28,478	8,529
Coffee, cwts. ...	3,338	3.681	6,445	1,892
Essential Oil of Limes, gals. ...	82	81	153	207
Firewood, Wallaba, etc., tons	4,092	3,476	4,470	4,725
Gums, lbs. ...	1,526	None	866	None
Hides, No. ...	2,763	5,342	3,976	3,087
Kola-nuts, cwts. ...	2	None	None	None
Lime Juice, gals. ...	3,583	2,479	2,511	3,852
Lumber, ft. ...	86,713	44,288	116,988	122,501
Molasses, gallons ...	40,630	503,502	592,424	1,260,475
Pigs, No. ...	162	516	309	299
Railway sleepers, No	6,541	23,515	5,184	8,796
Rice, tons ...	4,972	3,580	1,725	4,627
Ricemeal, tons ...	15	None	None	None
Rubber, cwts. ...	33	None	146	203
Rum, gallons ...	1,370,559	725,522	480,129	638,397
Sheep, head .	26	6	None	1
Shingles, thousands	1,006	1,077	766	1,118
Sugar, tons ...	40,425	41,248	41,498	46,302
Timber, cub. ft. ...	66,518	134,535	136,272	79,272

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EDITORIAL NOTES.

THE IMPERIAL AGRICULTURAL RESEARCH CONFERENCE.

The Empire Marketing Board having made a grant to cover the expenses of the Agricultural Research Conference to be held in October, in London, one can look forward with confidence to a most successful meeting of the representatives and delegates who will attend. Some 70 of the delegates attending are from the oversea parts of the Empire.

The importance of agricultural research cannot be over-estimated. Scientific research workers probably do not achieve sudden spectacular results, but good work has already been accomplished. From the efforts of research workers, is due the fact that cows are bred which give larger yields, of milk and of meat, wheat yields a more abundant harvest, and nearly all agricultural products cost less and are of much better quality than they were a generation or two ago. Had agriculture stood still, our vast city populations to-day could not be fed.

It is due to research work that such great strides have been made. Nevertheless innumerable problems remain unsolved—problems which greatly ~~e~~ a ffect the practical worker.

When it is borne in mind that the lands within our Empire in various latitudes, present problems peculiar to each, it will be seen how valuable such a Conference becomes. Further, there are many areas within the Empire, our own Colony for example, which are but on the threshold of development and stand in need of all the scientific help and advice that can be obtained.

In Canada there are many thousands of acres of virgin land, still to be conquered by man and made to bring forth fruit. Insect pests and fungoid diseases still play havoc with certain crops all over the world. Cattle-raising was made possible over enormous tracts of South Africa, through immunization against cattle plague—in course of time we may expect that foot and mouth disease will be a thing of the past. In our own Colony research work in the breeding of seedling sugar-canes, saved the Staple Industry of the Colony.

Examples might easily be multiplied as to what research work has accomplished. With regard to the financial aspect, The United States of America certainly lead the way, since the sum devoted to agricultural research in the whole of the British Empire, is less than half the amount that is spent in the United States.

This Conference will emphasise the fact that the work being done in various parts of the Empire is of interest and importance to the Empire, as a whole. The links that now exist will be amplified and strengthened, and at least one result will be closer co-operation in agriculture throughout the whole Empire.

The chief subjects which will be discussed at the Conference, according to the Journal of the Ministry of Agriculture, will be the extension of the system of Imperial Bureaux from entomology and mycology to other departments of agricultural science; the interchange of information among agricultural research workers; the recruitment, training and interchange of workers; and the development of the chain of agricultural research stations throughout the Empire. The main meetings of the Conference will be held in London, Cambridge and Edinburgh.

Farmers and Accounts.

Most of our farmers, if asked the cost to produce and market any of their crops, are very often forced to reply that they have not the faintest idea. Even those owning a fair area under coffee and other permanent crops frequently fail to keep figures of their transactions. The fact is that most of our farmers have no system of book-keeping at all.

There is no necessity for any elaborate mass of figures, but all of our farmers should keep books, and at the end of the year, know precisely the yields of their crops, the amount they have realised and the cost of planting, reaping, transporting, etc.

Books too, should be kept in respect to livestock and poultry. The haphazard measures adopted by most of our small farmers is to be regretted. The younger generation taking the place of the old farmer, should see to it that a simple form of book-keeping is adopted, whereby the transactions on the farm can be clearly seen.

After all, Agriculture is a business and we cannot conceive how any business can be conducted without books. The farmer to be successful must have some business ability—and further, in these ever-changing days, he should keep himself as up-to-date as far as possible. He should know something about the markets his crops reach and should study their conditions.

FRUIT INDUSTRY.

In connexion with the proposals to establish a fruit industry in this Colony, we fully endorse the remarks made by Mr. Stollmeyer at a recent meeting of the Trinidad Agricultural Society. Mr Stollmeyer, who has spent a fair amount of time and money on growing and marketing fruits, stated *inter alia* :—

"In the first place it must be understood that nothing could be accomplished in a hurry. These things took time. It might be said that they had been trying to organise the industry for the past fifty years, but the fact remained

that up to now they had not gone about it in the proper way. It was all right to say why not market their oranges or their mangoes. In the first place they had to compete against highly organised associations. They all knew he had been engaged in shipping fruit for a few years and although he had been doing it, he had not reached the proper stage. Although he personally thought he had reached that stage, now that he had returned from the marketing centres he confessed that he had a good deal to learn. It would be surprising to know how much care was necessary in the marketing of fruit. Nobody here seemed to appreciate the great care necessary in the handling of fruit. Oranges, limes and mangoes should be handled as carefully as one would handle eggs."

Mr. Stollmeyer also voiced his opinion that as regards citrus cultivation, it was the grape fruit which held out the greatest promise of success in these parts.

The above is not meant to aim at any discouragement to fruit-growing in British Guiana, but rather to emphasise the importance of accurately assessing the difficulties to be overcome in connexion with highly specialised industries which require years for development on correct lines.

MEETING OF THE BOARD OF AGRICULTURE.

A meeting of the Board of Agriculture was held at the Court of Policy Hall on Tuesday, the 4th day of October, 1927, at 2.30 p.m. The following were present: Professor J. Sydney Dash, B.S.A., (Director of Science and Agriculture), Chairman, W. Francis, Esq., F.I.C., (Assistant Director of Science and Agriculture,) Deputy Chairman. L. D. Cleare, Esq., F.E.S. Economic Biologist; Captain E. Beckett, F.L.S., S. H. Bayley, Esq., the Hon. G.L.B. Gall; the Hon. J. Mullin: H. L. Humphrys, Esq., S. M. DeFreitas, Esq., M.A., F.R.: J. J. Da Silva Esq. H. Aaron Britton, Esq., President, British Guiana Farmers' Conference, T. Earle, Esq., with E. M. Peterkin, Esq., Secretary.

Mr. H. L. Humphrys said that as the senior unofficial member, on behalf of the Board, he wished to welcome Professor Dash. He felt sure that the members were willing to co-operate with him in any scheme he brought forward for the benefit of agriculture, and he assured the Chairman that they would try to make his burden as light as possible.

The Professor thanked Mr. Humphrys for his sentiments, and said that he would take all the steps he could so as to revive interest in agricultural problems.

The minutes of the previous meeting held on April 26, 1927, having been circulated to the members of the Board and having received their approval were taken as read and confirmed.

The Chairman reported:—

His assumption of duty as Director of Science and Agriculture and Chairman, Board of Agriculture, on July 14th, 1927.

Leave of absence granted Mr. S. M. DeFreitas, M.A., F.R. Leave of absence granted Mr. T. Earle.

The reappointment of the following gentlemen as Ordinary Members of the Board for a further period of three years:

The Commissioner of Lands and Mines. The representative of the Royal Agricultural and Commercial Society. The Assistant Director of Science and Agriculture. The Superintendent, Botanic Gardens (vacant). S.H. Bayley, Esq. Captain E. Beckett, F.L.S. T. Earle, Esq., H. L. Humphrys, Esq., the Hon. R. E. Brassington. Tl e Hon. W. M. B. Shields.

The appointment of the Assistant Botanist and Mycologist as an ex-officio member of the Board.

The affiliation of the following Associations :— British Guiana Farmers' Conference, 1927. No. 1 Canal Farming Association, 1927. Plaisance-Sparendaam Association, 1927. Stanleytown Farmers' Association, 1927. Victoria-Belfield Agricultural Association, 1927.

The Chairman stated that the estimated Rice Crop for 1927 was 42,950 acres and that the yield would probably be more than 343,600 bags of cleaned rice.

The Chairman reported that a pure bred Shropshire sheep valued $85 had been attacked in the Botanic Gardens by Mr. A. P. Camisuli's dog, and the matter was receiving the attention of the Government with regards to what action should be taken in the matter.

Mr De Freitas said he thought the imported sheep in the Botanic Gardens should be shorn.

The Chairman said he would look into the matter with the Veterinary Surgeon.

The exchange of the Stallion "Waterbass" from this Colony with the Stallion "Nelsweep" from Trinidad was reported by the Chairman.

Mr. Britton enquired about the activities of "Nelsweep" since its arrival in the Colony, which the Chairman said he had asked for but had not been able to obtain in time for the meeting.

The following were laid on the table for general information:—

Movements of Stallion Donkey "Clay King. Movements of Stallion Donkey "Tip Top". Mr. Britton inquired about the arrangements being made for the animals to go into the country. The Chairman said he recognised

the importance of having them distributed about the country, but the impression he had got was that they were not very well looked after when they were there—they had lost two animals recently and it looked as though they were going to lose a third—he suggested that they should be brought back to the Gardens where people could take their animals until better arrangements could be made. The risks appeared to be great. He hoped to inaugurate a live stock policy in connexion with the re-organisation of the Department and the matter would then receive definite attention,

Mr. De Freitas said he thought a thorough revision of the breeding policy was very necessary, and by the bulls going into the country it was the only practicable way of broadcasting good stock. The Chairman said he was looking into the question and at present he did not care to say anything about the new policy.

The Chairman also laid on the table the Journal of the Board of Agriculture, Volumes XX, Nos. 2 and 3. He said he was not at all proud of it as it at present stood, and he did not think they would have any very great and rapid progresss in putting out a Journal of that type until they got going with their agricultural policy. There was too much "scissors and paste" in it to suit him. The tendency to fill it with popular articles was a dangerous one in many ways, particularly in regard to generalisation. and the inaccuracies which they very often contained, and such articles would be blue-penciled in the future. The popular article was usually of a general nature and contained matter which might or might not work in places other than that for which it was particularly written. The policy of the Department would be to provide efficient and reliable matter so that the farmers could be guided thereby. They had to reach the farmer by a series of leaflets so that if there was no Journal and if there was no meeting of the Board for some months, he would still be able to get information in connexion with the planting of his crops. The whole question of publication was receiving attention

in the new order of things, and he promised them that so far as the Department had anything to do with the publication of the Journal, it would be all improved.

In connection with the By-Laws for the control of the Plant Quarantine Station, the Chairman said that the by-laws had been printed and laid on the table, but he proposed to move the Quarantine Station from Brickdam which was not suitable. In the meantime, however, there was a new Order in connection with the importation of soil which he was bringing forward for confirmation, the question of the importation of plants being one which was undergoing consideration by himself and the scientific officers of the Board. At present they had very loose and lax laws in this connection, and he did not wish to run the risk of bringing in any disease in the soil and have it spread all over the Colony. So far, they had been keeping practically free, but at the same time, they must take all precaution to avoid danger in the future. There was more transportation in these days than in the past, and one of the duties of the new Department would be to protect all agriculture from the intrusion of any such pests or disease which might get in and be difficult to control.

In reply to Mr. De Freitas asking whether the new Order would prevent the importation of rose plants from Barbados, the Chairman said that Barbados was one of the worst places to bring in soils from.

Mr. Britton said that he hoped that in the interest of the local farmer, steps would be taken to prevent the importation of plantains from Suriname. The Chairman said that the matter was under consideration, but that nothing could be done at present.

On the motion of Mr. S. H. Bayley, seconded by Mr. G. Beckles Gall, the undermentioned Order of the Board of Agriculture under Section 3 of the Plant Diseases and Pests (Prevention) Ordinance No. 26 of 1920, was then unanimously confirmed.

ORDER OF THE BOARD OF AGRICULTURE.

Whereas it is enacted by Section 3 of the Plant Diseases and Pests Prevention Ordinance, 1920, that it

shall be lawful for the Board of Agriculture to prohibit the importation of any description of earth or soil, or any article packed therein, or any package covering, or thing which is likely to be a means of introducing into the Colony any plant diseases ;

NOW, THEREFORE, the Board of Agriculture hereby prohibits the importation from any country or place whatsoever of any kind of earth or soil, including leaf mould, or wrappings, cases, packages or other coverings which contain or have contained such earth or soil, or any article or material of whatever kind packed with such earth or soil : Provided that nothing in this Order shall apply to the importation of earth or soil by the Director of Science and Agriculture for scientific or agricutural purposes

Made by the Board of Agricultnre under Section of the Plant Diseases and Pests (Prevention) Ordinane No. 26 of 1920, this 4th day of October, 1927.

The programme of Agricultural Shows for 1928 was discussed. The Chairman outlined the policy hitherto adopted, which is as follows:—

Biennial Shows in 22 diffierent Districts 4 or 5 Districts each year—Grants $200 each.

County Exhibitions at Suddie, New Amsterdam, and North West District in alternative years—Grant $1,000.

Colonial Exhibitions once in 3 or 5 years to be held in Georgetown in which year no County Exhibition will be held—Grant $5,000.

Farmers' Competition every year in suitable districts —Grant $120 each.

For 1926 the sum of $1,500 was required to be used thus:—

3 District Shows at $200 each	... ...	$ 600
Farmers' Competitions	... ...	$ 600
Affiliation Grants	... ...	$ 180
Departmental Expenses	... ...	$ 120
		$1,500

The Chairman further stated that owing to the drought the Berbice County Exhibition was postponed from 1926 to 1927, and the Georgetown Exhibition from 1927 to 1928—it was thought advisable that the Georgetown Exhibition be now postponed to the early part of 1929 in order to give the new Department an opportunity of getting into its stride and to bring off something which was worthy of the Colony.

Mr. De Freitas said he welcomed the idea. He felt that the multiplicity of shows in the Colony did not improve or foster agricultural development. They had a number of petty shows all over the Colony at which many articles of poor quality were exhibited, and he felt that this was a subject which Professor Dash might consider with a view to finding whether a more constructive policy could not be devised. He thought a large Colonial Show should be held annually in the City. Professor Dash said he could be depended upon to see that the matter received the most careful consideration by the Department. He did not think the sum was excessive. In his opinion the judges had things in their hands. They had no right to award prizes where exhibits did not come up to standard. He agreed that the money might be better spent, but he felt that farmer's competitions of standing field crops were valuable things.

A letter from the Honorary Secretary, Essequibo Agricultural Association, *re* grading of Rice and Copra, was read.

Mr. Britton moved that the matter was not properly before the Board, as it should have been sent to the Farmers' Conference before it reached the Board.

The Chairman stated that this was a matter that Mr. Britton could take up with the Association; in so far as the subject matter of the letter was concerned the question was raised in 1924 when a Joint Committee of the Government and the Chamber of Commerce reported on it.

The Chairman here referred to the report and gave a summary of the findings as communicated to the Colonial Secretary by the late Sir John Harrison. While he (the speaker) agreed with the summary generally it perhaps

did not take into account all of the points connected with the matter as were known at the present time and it would be neccessary for him to call attention just for a moment to one or two essential points with respect to the question of grading, and particularly as it applied to rice. The question of grading was not such an easy one as some persons seemed to think. Throughout the country they had one type of rice which was grown to any extent and which was at its best in Essequibo. Grown under such conditions, it was of a high quality and fine type of grain. The West Indian markets, generally speaking called for a low priced rice, and it not infrequently happened that good and bad rice were blended to meet the demands. There were different types such as the three or four months rices which they had never considered. All their rice was practically of the five months type. It would be hard under such circumstances to establish legal grades for the reason that there was much room for differences of opinion with respect to grades based on appearance only. Thus cereals were not like fruit in matters of size, colour, freedom from pest, etc., making the latter more easily judged. It was a question of growing their rice to meet the demand. They tried to meet the price instead of meeting the demand which was greater for a rice with bolder grain and more body than the fine type now produced. Some of the shorter cycle rices judiciously used would help to supply this, at the same time permitting the crop to be more cheaply produced, and he was going into this aspect of the problem. They should try to get away from the question of grading as it was proposed, type being in his opinion more important than grade. He was not saying that grading was not a good thing, but it had to be worked in such a way, as not to be irksome to those engaged in the industry. He did not think, for instance, that the Department should be called upon to be policemen—moral or otherwise. The Department existed to give advice to farmers. If they had everybody—merchant, miller, grower—working together as a whole, the difficulty about inspection would be easily solved. They should work on comprehensive lines and have a great

association with sub-associations. He had no final statement to make in this matter. He was only giving them the trend of his opinion. The question of grading would be simplified when they had different types to offer which would be acceptable to markets.

With respect to the supply of seed for 1928, the Department was taking steps to meet it as far as they possibly could. They were taking steps to give supplies to those who required, and unless they got definite orders they could not book them. Some of the growers were rather vacillating and appeared to fear excessive prices. He was going out of Georgetown within a week on rice propaganda. They must stop all operations of shying or broad-casting rice. It was a waste. The people who did it had too much land. They should work in nurseries and transplant from nurseries. They had too, to avoid planting too closely.

Mr. Da Silva pointed out that some of the people who were given seed were ignorant.

Professor Dash said that the agricultural authorities should control the seed supply of the Colony.

Mr. Britton said that in connection with the three months crop it might be all right in Essequibo, but not necessarily so on the East Coast or in places where sugar estates were sandwiched between.

Professor Dash replied that his own opinion was that they had in Essequibo a rice-growing country and they should make Essequibo their centre for exporting rice. It was going out of sugar and it should come into rice.

The following questions and motions by Mr. Britton, left over from the last meeting, were dealt with :—

Question.—How many of the agricultural apprentices, who received training at the Botanic Gardens, have by Government been settled on the land, if none, why ?

Answer.—The Chairman stated in reply that 34 lads had completed their term, 9 of whom had been awarded grants of $150 each. The system was very unsatisfactory and he intended taking steps to remedy it as soon as possible.

Question.—Whether or not steps will be taken to import about 50 lbs of English Potatoes suitable for planting ?

Answer.—The Chairman stated that he did not think that they could do much with this matter, but it was being considered with other crops.

Question.—That the charge for Poultry Eggs be reduced by 50 per cent.

Answer.—The Chairman stated that this would be dealt with when there was some definite policy, but at present there were hardly any eggs or stock for sale.

Motion.—That in the interest of developing and maintaining an Export Trade of Produce by small farmers, it is necessary that Produce Inspectors be appointed.

Answer.—The Chairman said that he did not think that the Department, which was an instructive one, should have police duties attached to it.

The Chairman stated that in the future such matters could be dealt with departmentally rather than at a meeting where they might have interminable discussion and be unable to arrive at any definite conclusion.

The Chairman then gave a summary of many of his observations since assuming his office.

Running briefly over the situation, there were some impressions to be corrected, and he was only able to give the trend, as it were, of the opinions he had formed. Certainly nothing that he said should be regarded in the nature of a definite pronouncement.

Taking the sugar Industry, he went on, he had already discussed the policy of the Department with those interested and he thought that the outcome of that should lead to improvement in the future prospects of the industry. He therefore did not intend elaborating the point further. From a general point of view there was the question of the small factory : the position was very difficult for small factories in these days, and he could only re-iterate what had been impressed already : that they should aim at co-operative factories and establish these on broad lines. It was a recognised thing, and he only mentioned the fact then because he wanted all to know that anything co-operative would meet with his approval and assistance.

The question of cane farming had been frequently raised. On that he saw little possibility under British Guiana's conditions. The small agriculturists here had an

alternative money crop, and that a quick one, and the small man was not always willing to wait for prices. The factory owner was not always ready to risk anything and he viewed cane farming possibilities at the present time as really poor. He was aware that cane farming was prospering in many places where sugar was the only crop and the factories had engaged themselves definitely in cane-farming polices. Though he saw very little hope at the present time he said that when the Colony got an increase in population they might get small communities in places away from the main towns, which might run small "community" mills, making syrup for their own consumption. This would be in places where they were far away from the factories and unable to reap the benefit of sugar and molasses, and so on. It was all a question for the future.

The rice business he had gone into already during the earlier part of the meeting.

Plantains.

Plantains were another product, and the Department had already taken steps to study varieties, growth and habits, and that brought in the question of pruning to secure bunches at the right time. They had also gone into the matter of by-products on a small scale, in the manufacture of plantain chips and plantain meal, and it amounted to this: that after the plantain had been taken out of its jacket it became a luxury. Eleven cents a pound was the figure at which they had produced plantain flour working on their small scale, whereas wheat flour was sellling at 6 cents. It was all a matter of reducing the cost of plantain flour. They had worked out their experiments at 12 cents a bunch for a bunch of 48 plantains. Of course, if they could get the price down cheap enough to balance with wheat it might become an inducement to the local bakers to make a mixture and get a very nourishing bread, but they had to produce exceedingly cheaply to compete against the big wheat countries.

They had tried several experiments, in which he was indebted to Mr. Francis, testing, among other things, the five-hours sun dried, the seven-hours oven dried and the

vacuum method, which last did not succeed. The percentage of flour obtained from the peeled plantains was about 40 to 42 per cent. and if the skins were included they got only about 25 per cent. Unless plantains were almost given away it did not seem that with any of the ordinary facilities for maufacture they would be able to do much with them. He was making preparations to have half a ton of flour made to check up the figures on a big basis. They might be able to do something more with the green bunches if they could increase shipments to the northern islands ; but that was a commercial problem.

Coconuts.

Coming to the more permanent crops, he began with coconuts, which was an important industry and which had a chance to expand. In the past, cultivators had in many instances planted in wrong situations, and if they had selected the right places, preferably sandy locations it would have been better for the industry. In order to solve the problems of sand reefs, etc., it would be necessary for the Department to carry out definite experiments, and he hoped to be able to do that soon.

The pegass lands and heavy clays were not suitable for coconuts, but the crop was a good one for working up by a population of this kind.

Coffee.

The next crop of any importance was coffee, but unfortunately they had given very little study to the varieties, etc., in the Colony. He noticed that the coffee plant here had been allowed to grow apparently without any care and he therefore had a great respect for the coffee plant after seeing it growing in some places in British Guiana. He believed there was an opportunity for hardy types, notably on the pegassy lands.

Citrus Fruit.

With respect to the question of citrus fruits, involving the lime question and citrus generally, he did not think that the conditions of the flat lands would allow citrus to be grown commercially. It was impossible to do much

with citrus in the flat heavy clays and it looked to him that if citrus fruits were to be established at all it would be in the North West. He intended to go through the district and investigate the whole situation up there, for he understood that abandoned lime trees were growing there and were free from "wither-tip," the disease which had destroyed so many of the island plantations. He believed that they probably had the nucleus of that industry in the North West, probably with coffee and cassava as additional crops. There might be sand reefs in other parts of the Colony which would favour the lime cultivation, and something might be done provided they were protected from wind, which was the deadly enemy of all citrus plants.

Bananas.

Dealing with the bananas, he said that he had already made statements which he did not think he need change. So far as investigations were concerned they were taking steps to study local varieties, and further than that they need not go because the Imperial College was doing it all at their very doorsteps. He thought he was safe in saying that he knew the banana situation at the present time as well as anybody else and he felt that they need not do anything further than they were doing.

Oil Crops.

The next heading he would consider was oil crops other than Coconut. Much had been done with the pea-nut and it was said that there were large areas in the Colony that could be used for pea-nut cultivation. He had not seen them yet but he was keeping a very open mind on the subject. There were three important factors: the kind of soil which would allow the free use of implements that would reduce the cost of labour: the climatic conditions to allow the vines to mature, and he was not sure that the Colony had those conditions. They had only got one variety which seemed to fit in with the requirements. A third factor was the necessity of having a suitable rotation crop as pea-nuts could not be grown continuously on the same land.

Three samples (which were exhibited at the meeting) had been brought down from Pln. Cecilia and the "Bunch" type had proved by far the best both for easy reaping and from the point of view of uniform maturity. It was very splendid indeed of His Excellency to start the experiment at "Cecilia," if only to demonstrate the possibilities of the local industry. Last year the people of the Colony consumed something like half a million pounds of pea-nuts and the small man could go for them, if only for local chewing. They had not got the real oil nut yet. In conclusion, he saw possibilities for a local industry, but none at present for a great export trade.

He was making efforts to retain "Cecilia" to run it as a sort of sub-station to the Botanic Gardens,(which it was thought were a sort of El Dorado where everything could be grown) and use it for minor crops—tobacco, pineapples, pulses, etc., which could not be cultivated successfully in the Gardens. He wished to add on the question of pea- nuts that he had got into touch with the United States about the machinery for experiments in the industry generally.

He had samples of Soya beans, which were also on exhibit, and he said that it was a crop which was attracting a great deal of attention at the present time and had attracted a certain amount of attention in the West Indies in the past. The conditions had not been sufficiently understood. There were two factors: the Soya bean responded to long day illumination; and as a leguminous plant had certain soil organisms associated with it which they had not yet been able to establish in West Indian soils. By "West Indian" he referred to whole of the Caribbean. He had done some work at the Imperial College of Tropical Agriculture on the Soya bean, and those samples were ones he had brought along with him.

Miscellaneous.

In respect to fibres, what he had seen from "*Urena lobata*" appeared to be of value, but about the rest he could make no pronouncement at all. The fibre question was an economic problem.

For starches there was a fair demand in the European market. He had already noted cassava, but it was wise to mention that most of the European supplies came from without the Empire.

The European demand for pulses was also considerable, but it called for a definite product, but anything like spots on the grain cut the prices heavily.

The cocoa situation did not seen to be too healthy, and the Colony did not appear to have the conditions for any great development in this industry. All the trees he had seen appeared to be "struggling" very much to live.

Live Stock.

On the question of live stock he said that in this Colony there were numerous animals but all were "scrubby." There were possibilities for working it up. Little had been done with the draught-ox, and there were certainly possibilities with the buffalo, which gave a milk extremely rich in butter-fat which could be manufactured into butter and ghee, such as the Indians used. Then, of course, there was the beef end of it, but he was not stressing that. They wanted to aim at producing a hardy class, as pure bred stock demanded special conditions which it would be hard to meet.

Unless something was done their live stock activities would certainly tend to drift. They might compete a little with the Venezuelans, if they got the right class of animals, but there was the question of transport to figure on. If they could possibly bring it about to have a little earlier maturing class of beef animal they might do something. He again stressed the buffalo and the draught-ox as good lines to take up. In the small stock line there was the goat—a most useful animal which played a great part in infantile health—and they could do something more with poultry, having the products with which to feed it produced in rice mills.

On the motion of Mr. Mullin, seconded by Mr. Earle, a vote of thanks was accorded the Chairman for his address.

The meeting was then adjourned.

B. G. ASSOCIATED DISTRICT AGRICULTURAL SOCIETIES' CONFERENCE.

The Tenth Annual Conference of the British Guiana Associated District Agricultural Societies was held in two sessions in Berbice, on Tuesday, the 9th August, the first taking place at the Friends Scots Church, and the second at New Amsterdam Town Hall. There was a large gathering over which the president, Mr. H. Aaron Britton, presided. The following delegates attended: Messrs. H. A. Thompson, John Adams and Colin Adams (Victoria-Belfield), H. W. Grant, J. R. Straughn and D. A. Proffit, (Beterverwagting), Nathaniel Worrel, R. P. Carryl, Amos Hinds and John Lewis, (Stanleytown, West Bank), J. E. Fox and D. A. Glasgow, (Buxton and Friendship), H. L. Palmer and R. Holder, (West Bank), and P. J. Galloway (Evesham), J. Z. Peters, J. Aaron, H. Christian (Berbice) and D. D. Haynes (Mahaicony), with Messrs. E. M. Morgan, H. Matthews, D. Bishop, Dr. T. T. Nichols, the Rev. A. E. Dyett, Mr. J. Eleazar, F.R., and Professor J. Sydney Dash, B.S.A., Director of Science and Agriculture and Mr. E. M Peterkin.

CONFERENCE WELCOMED.

Mr. J. E. Henry welcomed Conference to Berbice For many years, he said, they had been seeing what could be done to build up a healthy peasantry proprietorship and he hoped that in this, the first Conference with Professor Dash they will make a leap forward.

Replying, the honorary secretary, Mr. R. R. Baird, thanked the Berbice Association for its invitation and cordial welcome. This, he said, was their eleventh assembly and they had been living and carrying on for a decade. They had begun another decade with the great privilege of having the new Director of Science and Agricultnre among them. They were looking forward to a great awakening in matters agricultural in the Colony and regarded very highly the privilege which Professor Dash had conferred upon them in being present that day to declare Conference open.

Conference Declared Open.

In declaring conference open Professor Dash said: Mr. Chairman, ladies and gentlemen—I am very glad to be here to-day at the Eleventh Annual Confernce in response to the kind invitation of your president. I wish to thank both speakers for their kind references of welcome. It is very gratifying to meet, so soon after my arrival in the colony, such a large number of practical agriculturists. In the first place, I want to thank you, sir, for the very kind telegram which you sent me, when in Trinidad, on the announcement of my appointment to the present post. (Applause). I take it as a happy augury of the good relations, which, I am sure, will exist between us. I want, in the next place, to assure you that my sympathies are entirely agricultural. I have lived among agriculturists all my life and I believe I know their point of view. All my best friends are agriculturists. (Applause). Throughout my whole career I have not found one unpleasant incident between myself and any agriculturist. (Renewed applause). You can be sure that any project, however great or however small, that has any chance of success is not going to be neglected. (Applause). But on the other hand, I am bound to tell you that speculative ventures or wild cat schemes will be severely left alone. I say this because I feel that there is a feeling of restlessness in the agricultural atmosphere that is not conducive to soundness, and I am quite determined that nothing should swerve me from doing all I can to conserve your interests and the colony's interests. It is probable that we may not see eye to eye on every occasion—it would be strange if we did—but I am sure that as time goes on you will come to regard me as a real friend. (Loud applause).

The Present Position.

Now the position is just this—that haphazard methods will have to give place to those that call for close study and investigation. I am just giving you an idea. This colony is just beginning its development. Its agricultural possibilities have hardly been scratched. One of the first essentials for development is an active and vigorous

Department of Agriculture, equipped with vital necessities—not luxuries—for the building up of the whole structure of our economic life Such a department must be regarded as a sound investment, and it must be substantially housed, if it must function efficiently. Modern departments of agriculture are undergoing a change in keeping with present-day conditions. Present-day land problems can no longer be solved in museums and gardens, however useful such institutions may be. I for one will not want to deprive them of their value. But, sir, the fact is that the mere introduction of a plant, or a seed, or an animal under present-day conditions is nothing compared with the difficulties and impingements to be surmounted and understood in the establishment of new crops, new industries, new methods; for after all, Mr. Chairman, agriculture primarily is a business—the greatest business in life—and its success or failure must be adjudged in strictly business terms.

Reconstruction of Agricultural Department.

I am in the process, at the present time, of planning a strong department in which all the agricultural interests of the colony are receiving full consideration. I hope before long that these plans will be ready for submission to His Excellency the Governor. I mention this now because I hope it will suffice at this juncture. In the meantime as an agriculturist I appeal to you and to every agriculturist in the colony to let us unite and pull together and co-operate most heartily in the work which lies before us,—building up the whole fabric of our agricultural interests. In conclusion let me express the hope that your deliberations may be uplifting, may be imaginative, all tending towards that prosperity and happiness which we so much desire. (Loud applause.)

The President then replied at some length.

The Presidential Address.

The following is a precis of the President's address:—

Members of Conference and friends: To-day for a second time since its inception the Conference assembles in

the county of Berbice, and that under very happy auspices for those on whose behalf the conference is functioning.

THE NEW DIRECTOR.

On 22nd April last, it was publicly announced that the Secretary of State for the Colonies had chosen Professor J. Sydney Dash, B.S.A., of the Imperial College of Tropical Agriculture as Director of Science and Agriculture in succession to Mr. W. Nowell. Professor Dash arrived in the colony on the 14th ultimo and assumed the duties of his office on the next day. His is in by no means an enviable position, but from the published interview he accorded to the press, it is no exaggeration to say that in Professor Dash it seems that the colony has been peculiarly fortunate in getting that type and class of official required to give the colony a move on agriculturally. The number of things that were put down pending the advent to these shores of the new Director for him to deal with, are so many that an individual with a less stout heart than Professor Dash, would already have been casting his eyes about to get out. We fervently hope that the Professor will live up to the visioned interview he accorded to the Press, and thus make it possible for the Colony within a short time not only to be capable of producing a sustained supply of fruits and vegetables for local demands, but of establishing an export trade.

BACK TO THE LAND.

It is gratifying to record that in those districts where modern pumping plants have been installed and drainage reasonably assured, there had been a steady return to the land with the result that the acreage under cultivation in those districts as also the Canals Polder, have been largely increased. As a consequence ground provisions are being sold unremuneratively.

It should be recorded that at no previous time in the history of the colony has there been so determined an effort on the part of the small farmers to put in permanent crops, with the result that the supply at the Botanic Gardens has proved inadequate. It is to be hoped that in the re-organisation of the department, the Director will give

sympathetic consideration to the views of the Conference as regards the Superintendent of the Botanic Gardens, which were forwarded by way of a resolution to the Executive Government some time ago. There can be no doubt about its being a waste of money in having highly trained and technical officers engaged in clerical work, whereas it would make for greater efficiency to have such officers engaged in out-door work.

FRUIT.

Surely it is not too much to expect that the Governor, who is now a practical farmer, will bring about the promised conference over the Joint Report for the Experimental Farms approved by the Board of Agriculture and concerning which the late Professor Sir John Harrison thought that the opinion of his successor should be had. It appears to me that the establishment of these stations would not be of any great financial burden to the colony if steps be taken to procure a grant from the £1,000,000 Imperial Vote to foster new industries as indicated in the Report of the Economic Committee. I am greatly indebted to Mr. Cecil Farrar, Persident of the Georgetown Chamber of Commerce, through whose courtesy I was in the first instance permitted to peruse the said report, or to be strictly correct, the fruit section of the Report.

CASSAVA STARCH.

The Chamber of Commerce continue to assist and cooperate with us. Just a few weeks ago samples of cassava starch made from (a) rain water, (b) artesian well water, and (c) reservoir or creek water, for transmission to England were submitted for purposes of analysis.

Once it is established that we can put on the market a starch in quality equal to that sent from Brazil, co-operative efforts will then be made to produce and put it out at a price to compete successfully on the market, therefore the farmers should adopt as their slogan "Mass Production as a way of Prosperity" which is possible by continuous labour and intensive cultivation.

At present in the Colony is Mr. H. C. Sampson, C.I.E., Botanist on the staff of the Kew Gardens. His visit is

due largely to the efforts of Sir Edward Davson, Bart., and of His Excellency the Governor. How long Mr. Sampson will remain in this colony is not known nor is his programme ; but whatever is done we plead with those concerned to let him be given the opportunity of visiting the farms of villages in different parts of the colony and also of making a thorough inspection of the coconut cultivation of which he is a recognised authority. It ishoped that the visit of Mr. Sampson is the first of a series of periodic visits to the colony by athorities of the various branches of agriculture.

Cattle Rearing.

Following upon the excellent, practical address by Mr. Stanley M. deFreitas, at the public meeting last year, efforts have been made to improve the breed of cattle. The effort has not been productive of the desired results because of the failure on the part of the Department of Science and Agriculture to arrange for the placing in the country districts of the pedigree sires. There can be no doubt that the inauguration of such a policy will in a few years result in as marked an improvement in cattle as is the case with donkeys.

Shows.

Since last we met there took place two shows. — A County Show on the race course, New Amsterdam, Berbice, on the 31st March and 1st April last, and a District Show by the Beterverwagting-Triumph Farming Association in St. Mary's school-room on 20th April. Both shows came off successfully under favourable weather conditions.

Produce Agency.

The Agency in Georgetown under Government control is still plodding on in the face of concerted opposition by the middle-man. Added to that serious handicap is the fact that the Committee conducting it is not as representative as it ought to be. During the year and largely through the efforts of Mr. E. M. Morgan, Agricultural Instructor, a similar agency was launched in the New Amsterdam market.

VISITORS.

During the earlier months of the year there came to the colony Mr. H. T. Pooley, Director of the British Empire Producers' Organization and Deputy Director of the Sugar Federation of the British Empire. Accepting an invitation from the Conference and accompanied by members of the Executive Committee, Mr. Pooley made a tour of the villages of Kitty and Alexanderville, Plaisance, Sparendaam,, Beterverwagting, Triumph and Buxton-Friendship. At the last-named District through the Chairman of the Local Authority and the District Farming Association, it was made possible for the visitor to inspect a portion of the cultivated areas. He expressed his pleasure and suggested co-operation in cultivating, reaping, and marketing.

CONCLUSION.

In conclusion let me enjoin farmers now that there is in our midst a live head or the Department of Science and Agriculture who will shortly formulate a sound agricultural policy that they should avail themselves of the services of the Agricultural Instructors and by means of co-operative planting, co-operative harvesting and co-operative marketing, produce first-grade articles. Doing that they will come into their own, and the Colony because of their agricultural activities will become in fact the Magnificent Province.

DISTRICT AGRICULTURAL ACTIVITIES.

The Resident and District Agricultural Instructors have been actively engaged during the last quarter. In the North Western District, Mr. E. M. Morgan is now in charge of the station at Issorora. Experiments with the following varieties of Cassava have been started at this Station: "White stick," "Contention," "Fine Leaf," (white and red) and "Butter stick;" whilst seed beds of Seville Oranges and Limes have been established. Attention has been given to the river and creek dams.

Mr. Matthews, in Berbice, has been impressing upon all rice farmers the great importance of planting improved rice seed, as well as giving encouragement and advice to the the provision farmers and urging the planting of groundnuts where the soil is suitable.

On the East Coast of Demerara, Mr. Dowding has been busy in many ways. The Farmers' Competitions, by which prizes are given for standing 'crops in the field have occupied a portion of his time, while he has also been actively engaged in visiting all rice farmers and urging them to make a concentrated effort to obtain good seed padi for their next crop. He is also making an attempt to get farmers to keep some record of returns and expenses, in connexion with their ordinary crops. The usual routine of instruction has also been carried out—efforts at improvement of "land drainage" and "arterial drainage" have not been lost sight of. The mulching of plots with rice Straw has been persistently urged, as well as the improvement of pasture lands. He has paid regular visits of inspection to culivation, in his district including the ground-nut cultivation at Pln. "Cecilia."

In the Pomeroon, Mr. H. B. France has been making a serious attempt to improve the station at Marlborough. Attention has been given to the eradication of para grass (*Panicum barbinode*) from which pest the Station suffers materially. He has planted some ginger, started basket-making for furnishing coffee and other plants to the farmers; varieties of cassava and broom-corn have also been planted.

He has visited many of the farms, giving practical instruction in connexion with coconut and coffee cultivations and has assisted farmers in the laying out of their lands where new cultivations have been started. Special attention has been paid by him to young coffee plantations with a view to the avoiding of mistakes that have been made by the older cultivators—mistakes the remedying of which are difficult, if not impracticable, when the cultivation has long reached maturity.

Mr. T. A. Archer, in his district on the West Coast of Demerara extending to Parika and including the island of Leguan, has been engaged in inspecting the various cultivations of rice and discussing with growers the urgent necessity of eradicating bad seed padi and securing selected seed-padi from this Department. The provision farmers have not been neglected, and good and sensible advice has been given them in connexion with their crops.

Mr. J. M. Antrobus, in the Polder District, has been occupied with the Farmers' Competition in his District and has visited most of the farms, giving advice as to the pruning of coffee, cacao, and fruit trees, the improvement of drainage and the planting of ground provisions.

Mr. Humphrys, on the East Bank of the Demerara river, has been urging the importance of more care being taken with coffee and cacao and the selection of coconuts for seed purposes. The importance of better tillage has has been stressed as well as sanitation in coconut fields. Rice farmers have also not been neglected.

Mr. R. R. Ross on the West Coast of Berbice has been pointing out to his farmers the need for rotation of crops, has been urging where conditions are favourable, the cultivation of ground-nuts, arrow-root and bitter cassava, the necessity of giving more attention to their permanent crops and the need for sanitation in coconut fields. In certain parts of his district he has been endeavouring to get farmers to extend their sweet potato areas. He has also been very busy amongst rice farmers and has pointed out the advisibility of obtaining selected seed padi from the Department.

Mr. Fingall on the upper Corentyne has been occupied with the rice farmers in his district. The importance of obtaining their seed padi through the Department has been impressed upon all growers.

Mr. J. M. Cush on the Berbice river has reported on the poor quality of the padi grown in his district. He has forced upon rice growers the need for obtaining seed padi from the Department. He has also insisted upon better tillage in provision 'beds,' and the necessity for making an effort at planting more coffee, fruit and other permanent trees. He has pointed out that the area in plantains should be less, and more acres should be devoted to sweet potatoes, yams, pumpkins, eddoes and tannias, and various peas. He has pleaded for more interest in poultry-raising and pig-rearing and has given sound advice in this direction.

Mr. R. Pasea on the Essequibo coast, has been emphasising the importance of selection of seed in connexion with rice-padi and coconuts. On the larger properties he has instructed on the necessity for more mechanical appliances. Advice has also been given with respect to the removal of 'bird vine,' the planting of ground-nuts and the early planting of rice.

Mr. Wilson, whose work is amongst the Islands of the Essequibo river with the exception of Leguan, has been pushing the cultivation of ground-nuts. The necessity for rotation of crops has not escaped his attention whilst he has urged the selection of seed padi for the next crop.

Mr. Haynes, in the Mahaica-Mahaicony areas has been giving hints on the improvement of farmers' rice crops, practical lessons in the pruning of fruit and other trees, the growing of ground-nuts, the imporvement of drainage systems, the preparation of products for market, and arousing interest in various other ways.

J. E. B.

EXPERIMENTAL FIELDS.

The rice crop at the Experimental Fields has been reaped and has given excellent returns. Over 300 plants were selected and collected separately for starting progeny row plots, for the purpose of obtaining pure strains, and seed padi is now available.

A start has been made with a collection, of bananas, plantains and cassava for the purpose of study.

A bed has been planted in papayas for experimenting with the preparation of papain.

A series of vegetable plots is being laid out for the purpose of testing imported seed.

A start has also been made with the planting of green dressing plots, but the work has been handicapped owing to continuous dry weather.

His Excellency's ground nuts have been reaped and have given a fair return. The Virginia Bunch has been the most satisfactory as regards yield and the easiest to harvest. The runner varieties continue to run after their main crop is ripe thereby producing nuts in all stages of maturity.

A limited quantity of Virginia Bunch seed is available for distribution at 10 cents per lb. This may be booked through the Resident Agricultural Instructors who have been notified accordingly. A few estates have planted on a larger scale and have promised to let the Department have their crop for distribution, if required. The Director is entering into negotiations with an implement manufacturing company to supply the Department, if possible free of charge, with a peanut plough and other mechanical implements for experimental work in peanut cultivation and harvesting.

Pln. Cecilia, East Coast, the Govenor's plot which measures 1.7 acres is being developed as a sub-station, there being no sandy loam soils under the control of the Department. The land is being prepared for tobacco, pineapples, peanuts, jute, soya beans, onions, cover crops, etc. Ten varieties of tobacco and two varieties of Teneriffe onions have already been started in specially prepared nurseries.

Three hundred bags of selected seed padi have been purchased in Essequebo so as to enable rice farmers to obtain a larger supply of seed than is usually available at the Botanic Gardens. E.M.P.

WORK IN THE BOTANIC GARDENS AND NURSERIES.

During the past quarter horticultural activities in the Flower Garden section were pushed forward. The shrubs in the beds and borders have been pruned and the surrounding parapets prepared for the planting of annuals and perennials. The progress of this work however, has been somewhat interrupted by the continuous dry weather. In connection with the planting up of the parapets, a plan has been drawn up to mass, on the edges of the beds and borders, brightly-coloured subjects purely for effect and also to maintain a continuous display.

In order not to upset the floral scheme of the Flower Garden, arrangements are being made to select special sites for the growing of flowers for sale to the public.

Much progress has been made with the renovation of the lawns. One section has been completely renewed. This area has been ploughed, raised and levelled. The cultivation of Bahama grass (*Cynodon dactylon*) to carpet

the surface of the plots is receiving attention, and has already begun to be effective. The sections which were improved last year are being maintained in good order. When the other sections of the lawns are renewed the general aspect of the Gardens will be greatly enhanced.

Unsightly trees of spontaneous growth, and all rank vegetation around the lakes are being cleared to improve the water scenes. Openings have already been made which lend picturesqueness to the scenery of the lakes. Shrubs and palms which blocked the vistas of the gardens have been removed and transplanted. A fine prospect is now obtained of the water lilies as the circular bed situated at the head of the main drive is rounded. To enjoy this scene a visit should be made in the late afternoon, or soon after sunrise just when the *Victoria Regia* are in the prime of beauty. Another pleasing sight as one proceeds up the avenue is that of the Pink Lotus Lilies standing erect 3–4 feet above the water and looking like giant tulips.

The grounds approaching the lakes are being cleared of noxious weeds, and the vistas through this section of the gardens are also being improved by removing trees, and pruning away overhanging branches, which obstruct the view. It is desirable that these grounds be maintained in good order to harmonize with the lake effects and to improve the approaches to the lily ponds of the Blue Nymphaeas.

Nurseries :— In the ornamental section the stock of plants is being increased for sale. These include Maiden Hair Ferns, Begonias, Caladriums, Anthuriums, Alocasias, Ornamental Shrubs, Crotons, Hibiscus plants and several kinds of palms.

With a view of improving the fruit culture in the Colony, propagation of budded and grafted plants is receiving careful attention in the economic section of the Nurseries. Several hundred seedlings of citrus plants have already been basketed to be used as stock for budding purposes early next year. A further quantity of seed is being sown to maintain the supply of stocks as budding progresses. At present the budding and grafting of avocado

pear plants and the grafting of mangoes are being proceeded with. In consequence, the Director has issued instuctions that no seedlings of these kind of fruit trees are to be sold, as it is desirable that only reliable and known kinds of Pears, Mangoes and Citrus Fruits are to be cultivated, so as to displace the seedlings which are now offered for sale.

To encourage, too, the cultivation of vegetable gardening and to improve on the produce which is at present grown, the department has imported for sale a collection of vegetable seeds including Tomatoes, Cabbages, Beet, Radishes, Lettuce, etc. The seeds are parcelled out into packets to suit purchasers and can be obtained from the Resident Agricultural Instructors stationed at New Amsterdam, Berbice, and on the East Coast, Demerara, also at the Vegetable Products Depôt and at the Botanic Gardens. It is expected that market gardeners will avail themselves of obtaining seeds of proved quality, and even those who maintain home gardens should take advantage of this opportunity. The idea of continuing the importation of fresh vegetable seeds will depend on the success this trial shipment meets with, and future experimental work in this regard.

A. A. A.

PREPARATION OF CASSAVA STARCH AND TAPIOCA.

Cassava Starch, sometimes known as Brazilian arrowroot, is produced on a considerable scale in Brazil, United States, East Indies, West Africa, and elsewhere. The chief centres for the production of Tapioca are Malaya, Dutch East Indies, and Brazil.

The processes of manufacturing these two products are identical up to a certain point. They consist of essentially in grating the cleaned roots sufficiently finely to

break the cell walls and so liberate the starch, which is subsequently separated from the fibre and collected in tanks of water. For industrial purposes the starch is then dried, but if tapioca is to be made, the wet starch is placed on hot iron plates, which cause the grains to gelatinise and adhere together in lumps.

The machinery required depends on the quantity of roots available. On a small scale all the work can be carried out by hand, but where large quantities are dealt with, power driven machinery must be used. In either case the first essential to success is a plentiful supply of pure, soft water, free from iron or peaty matter. Rain water is preferable, but artesian well-water can be used if the iron is removed by aeration and filtration. Lamaha, river or trench water should not be used unless clarified and made colourless by one of the methods used for removing iron and organic matter. (*This Journal, Vol. XVI No. 2 page 160.*) Unless the water is pure the starch will be of inferior quality. Another essential is that the roots must be freshly dug

There are several types of machines employed for the preparation of cassava starch, and speaking generally, all the machinery used in a potato starch factory can be employed for cassava, although slight modifications in the character of the grating or pulping machines and of the sieves is necessary, cassava roots being more fibrous than potatoes and the starch grains smaller.

The roots arrive at the factory in all sizes. The larger ones are usually peeled, cut in pieces, and put into a cleaning tank. The smaller roots are placed at once in a washing machine, from which they are transferred automatically to a hopper leading to a pulping machine running at a high speed. The pulp is carried away in a stream of pure water to the starch separator, but is sometimes further treated in a mill to complete the disintegration of the cells and ensure the maximum yield of starch. The starch and water from the sieves are run into large settling tanks. The clear water is run off, and fresh water added,

the starch being stirred with paddles either by hand or mechanically. This process is repeated several times until all foreign matter has been eliminated; the starch is then allowed to settle in tanks of water.

There are several other processes for the extraction of the starch.

Samples af cassava starch from the Gold Coast and Natal have been examined at the Imperial Institute with the following results:—

	From Gold Coast.	*From Natal.*
	Per cent.	Per cent.
Starch	77.68	86.07
Moisture	21.68	13.84
Ash	0 06	0.09

W.F.

INSECT NOTES

Termites on the Gold Coast and Measures for their Control.

In a "Report on The Economic Importance of the damage due to Termites or White Ants in Accra and Achimota on the Gold Coast and the methods by which this loss may be curtailed," Mr. A. W. J. Pomeroy, Medical Entomologist, Medical Research Institute, Gold Coast, gives a detailed account of the Termites, or "Wood Ants" as they are called here, of that part of the Gold Coast. The report has a deal of information that is of importance to all tropical countries not only on the biology of these insects, but also on the means of combating them and the measures to be adopted in rendering buildings less liable to attack

Mr. Pomeroy as the result of his own investigations as well as from a survey of the work done in the past, submits three conclusions which appear pre-eminent. Firstly, that the biology of these insects is so different and so complex that no single specific means of artificial or natural control is likely to be discovered which will prove efficacious against all economic species ; secondly, that the damage can be reduced by a combination of methods namely :—the material endangered must be rendered inaccessible or as resistant as possible and the continuous maximum elimination of the main source of infestation must be carried out at the same time ; thirdly, from the results obtained it would appear that there is very good evidence that a definite economic profit will be shown if the project is carried out on a sound financial basis and with proved methods.

Part I. of the report will be touched upon only briefly here. It consists of observations on the most important economic species of the district, an account of the establishment of a nest, and observations on the construction of the nests of the various species of the insects. It is somewhat startling to note that "It is almost impossible in Accra

and Achminota, to find ten square yards of ground which does not exhibit some signs of Termite activity." The section concludes with a list of 55 species of Termites found on the Gold Coast.

Part II. deals with the possibilities of eliminating or materially reducing the incidence of Termites in the area under discussion. The infestation of two areas of 55.6 acres and 64.3 acres in the town of Accra is estimated at 3. nests and 2.6 nests per acre which were of serious importance. It is pointed out that the destruction of the nests alone will not secure immunity, and that the treated area should extend at least eight hundred yards beyond the point at which immunity is required.

The method used in the eradication of Termites from occupied land consists of (1) breaking up the nests with explosives, (2) subsequent fumigation of nests when necessary, and (3) ploughing the land and treating with various poisons. The large conical nests which often stand several feet high, and which have the interior hollow and partially filled with a comb-like structure of cemented earth, can be effectively and cheaply destroyed by treatment with fumes of burning sulphur and arsenic introduced by a Universal Ant Extermination.

The composite nests on account of their structure cannot be fumigated until they have been thoroughly shattered. For this purpose Gelignite has been found to be the cheapest and the most effective explosive. Holes are drilled in the nests by means of a specially constructed hand auger, being arranged around a central perpendicular hole three feet six inches deep, while the lateral holes are three feet deep and drilled at an angle of forty-five degrees (45°). The charge in the central hole is provided with a longer fuse so that this explosion takes place last allowing the charge to form a crater in the centre.

Fumigation is not always necessary and this cannot be ascertained until the nests have been blown up. When necessary the methods advocated are, the fumes of burning sulphur and arsenic, hydrocyanic acid gas, and chloride gas from a cylinder. The last method has not actually been

tried, and of the two former the sulphur-arsenic is the most successful.

After the nest has been destroyed and fumigated it is necessary to treat the ground with some poison such as sodium arsenite, sodium cyanide or arsenic mixed with dry earth, sand, or preferably, road dust.

Part III. deals with the prevention of Termite attacks and the destruction of Termites in buildings. So far there is no definite proof of any species on the Gold Coast which can infest a house by the introduction of the sexual winged forms, and the common economic species are all subterranean in their origin.

Houses can be built that with a modicum of care and attention will remain free from Termite attack. These houses are built on concrete piers each surrounded by a zinc course at least six inches in width, set in a belt of solid cement at an angle of 45° and continuous around each pier. The Termites are unable to construct galleries over the sharp edges of this course, and so gain access to the building proper. The approaches and steps must be guarded in the same way and no communication from the ground such as creeping vines, unguarded pipes, etc. be permitted. Raised buildings of this type are costly when compared with other types built on the ground, and a type recommended as affording considerable protection although not immune from Termite attack is that described by Snyder in U. S. Dept. Agric. Bull. 1472.

The defects likely to occur in concrete construction are then dealt with. Recommendations follow on the treatment of heavily infested buildings. It is suggested that in badly infested areas poisoned baits consisting of waste wood saturated with 10 per cent. of sodium arsenite be tried. It has been proved that Calomel is an effective poison and being insoluble passes through the excreta. This and the dead bodies are eagerly devoured by living Termites.

The report concludes with a summary, 11 plates and 2 maps.

L.D.C.

VETERINARY NOTES.

DISSEMINATION OF BOVINE TUBERCULOSIS TO MAN.

The relation of tuberculosis in animal to man has received considerable attention. In 1895 Rich reported five cases of tuberculosis in man where the disease could be undoubtedly traced to the use of milk from tuberculous animals. In 1897 Bailey of Massachusetts Board of Health reported cases of tuberculosis in children of non-tuberculous parents, in which the tuberculosis could be undoubtedly traced to milk infection. In the same year West reported that two children of Luther Bridges had recently died from tuberculosis, which was due from drinking the milk from a cow which, upon being killed, was found to be the subject of extensive tubercular disease, largely localized in the udder.

Five of Bridges nine children were at the time suffering from tuberculosis and several of them very ill. Now Rich reports the case of a farmer undoubtedly infected by milk from a tuberculosis cow. His case was for six weeks mistaken for typhoid fever. Shortly after his death intestinal tuberculosis was found in one of his children that was taking the milk from a cow with a tubercular udder. The father had used this milk in quantity even during his illness. The child had been removed when the father was taken sick and was probably not infected from the father. It died from tubercular meningitis.

In 1894 Smith reported a very careful study of the autopsy of a tuberculous herd owned by the Soldier's Home near Washington, D.C., which had been tested by the inspectors of the Bureau and upon which careful autopsies had been made.

This was one of the herds which had served for an experimental study in determining the value of tuberculin. Smith noted very carefully the location of the tuberculous lesios and the probable source of infection, and concluded that the infection of the mesenteric glands showed that the tubercle bacilli must have obtained access to the body by way of the disgestive processes, and perhaps at the same

time the aminal may have inhaled bacilli, and a second series of infection been started.

Smith reported a careful, comparative study of the bovine tubercle bacilli, and the human bacilli from sputum. He made careful morphological studies of the bacilli taken from human sputum, and of various bovine bacilli, and noted differences in the virulence of the disease from the various germs, the lesios which were produced upon experimental animals and the like, and brought out many other points which would indicate the possibility of a great many varieties of bacilli, and suggested many possible, important lines of investigation in the study of the bacilli, from various sources, both animal and human.

Trudeau and de Schweinitz had called attention to the fact, that the environment and food of the germ in different animal bodies might influence its appearance and pathogenic properties very materially.

Smith called attention to the differences in the morphological appearances of tubercle bacilli obtained from sputum and from a cat, which seem to be readily accounted for by the change in the nutritive media, upon which the germs developed either inside or outside of the animal body. As some animals are more susceptible to tuberculosis than others, and as practically almost all animals can be infected with tuberculosis, it would seem that there must be a possibility of more or less virulent or attenuated varieties of tubercle bacilli being established just exactly as a plant, the habitat of which is in a warm climate, by careful selection and cultivation, be gradually accustomed to more severe surroundings.

Whether we accept, however, the idea that tuberculosis is communicated from cattle to man very readily, or with difficulty, the fact remains that this disease amongst cattle is the cause of many dangers which should be avoided. Not only is it necessary to destroy tuberculous animals that are the source of infection for others, but it is also necessary to disinfect the stables thoroughly before they are used for housing healthy animals and absolutely to prohibited the attendance of tuberculous individuals upon healthy cattle.

S.N.B.

ROTATION OF CROPS.

The following instructive address was read by Mr. L. A. Brunton, Manager of the St. Augustine Experiment Station, at a meeting of the Agricultural Society of Trinidad and Tobago held on the 13th October.—Editor.

In all civilised countries where the value of land is high, and in consequence the necessity for a maximum crop production per unit of land is imperative, the knowledge of the soil and of the conditions best suited to each crop, gained through the accumulated experience of generations of practical agriculturists, has evolved amongst other essential agricutural practices, that of crop rotation.

In less advanced countries, particularly in the tropics, where fertile land is plentiful and cheap, and experience has not yet co-ordinated the knowledge of soils and conditions to the same extent, rotation of crops is seldom practised, but instead, what is aptly termed "Land Rotation" or "Shifting Agriculture" is resorted to, so as to maintain the fertility of the soil, when it is in danger of being impaired by the continuous cultivation of one crop.

This form of rotation has generally been adopted in the early development of new countries, and as it is based on the same general principles as crop rotation, viz. the maintenance of soil fertility and the avoidance of plant diseases, there is justification for its practice where the area of cultivable land is more than sufficient to support the population.

With the increase of population, however, the need for a less wasteful use of the land arises, and, as other means of maintaining the fertility of the soil under one crop prove inadequate, the advantages to be gained from a proper system of crop rotation became increasingly apparent.

As shifting agriculture and crop rotation aim at the same result, some consideration must be given to the former practice before dealing in detail with the latter,

Shifting agriculture or rotation of land follows very closely the methods employed by nature in building up vegetation; it ensures the fertility of the soil by avoiding the constant drain on plant food entailed in the continuous cropping of one area, and reduces the possibilities of damage to the crops by harmful bacteria, fungi, and insects. All observant planters are familiar with the variation from season to season, or in a series of years, of the vegetation on soil that is uncultivated, the low growing weeds and grasses give place, according to the nature of the soil, to taller and succulent, or coarser and hardier plants, which are succeeded by soft or hard stemmed bushes (Latrajo), amongst which quick growing soft stemmed trees spring up, to be followed, as the earlier growth dies out by hardier stemmed trees, which ultimately form the forest; by changing the cultivation from one piece of land the fertility of which has deteriorated, to a new piece whose fertility is unimpaired, and leaving the first piece uncultivated for a more or less extended period, the farmer is following nature's plan for the rejuvenation of the soil, but nature in this method may be economically wasteful, so that the limit to which the limited view of man, proverbially employed is governed by the time necessary for the soil to regain its former fertility, closely connected with which is the amount of cultivable land in relation to the population, in other words the unit of land necessary for the support of one unit of the population must be multiplied by the number of years required for the rejuvenation of that unit, thus, if it requires eight years for the soil to recuperate and one acre can support one individual for a year, then one square mile of country can only support eighty persons under a system of land rotation.

It can therefore be readily understood that being based on sound agricutural principles, the use of this system can be fully justified in thinly populated countries, but, that it becomes so wasteful both in land and time when the population increases beyond a certain limit, that the general impoverishment of the country must follow, and the need to conserve the land to enable it to support the larger population becomes so insistent, as to call for a change in

agricultural methods, rendering the adpotion of crop rotation, the only means by which this can be successfully accomplished, imperative.

The agricultural development of the majority of the West Indian Islands, justifies the belief that they are rapidly approaching the day when the foundation of their cultivation will be based on a carefully worked out rotation of crops. Increase of population, however, is not the only cause which has stimulated this agricultural development, the causes are diverse and vary in the different islands and even in different districts of the same island; in this connection it is significant that in Barbados, one of the most thickly populated regions of the world, where agrculture has reached a much higher development than in any other West Indian Colony, insect pests and diseases of the sugar cane have been brought under some measure of control by a modified system of crop rotation.

There appears to be little room for doubt that this Colony is faced with similar problems, not only in its major cultivation, sugar cane, but also in the minor crops of the small farmer and peasant proprietor, it is therefore necessary, that serious consideration should be given to any suggested changes in our present methods of cultivation which will help to solve, some at least, of the problems that confront us. It is with this object in view that these notes on the rotation of crops have been prepared.

Object of Crop Rotation.

The object of crop rotation is to keep the land in continuous cultivation at a minimum cost, while maintaining it at its highest point of productivity. By taking advantage of certain established facts with regard to plant life and the nature of soils this object is attained. These facts, and the advantages to be derived by utilising them, may be briefly summarised as follows.

1. Different plants utilise the inorganic elements of the soil in different propotions, and also differ very markedly in their capacity for absorbing their food constituents from the soil. The proof of this is to be found in the fact that the composition of the ashes of all plants is not the

same; thus it is found that some plants consume a large porportion of potash and phosphoric acid, others, while requiring less of these substances, absorb much silica, and yet others assimilate lime or magnesia in larger quantities than any other of the inorganic elements. For example, the amount of potash taken up from the soil by potatoes is about twice the amount required by cereals such as rice or maize, while these latter assimulate nearly three times the quantity of phosphoric acid that potash will absorb, again, rice takes up 100 per cent. more silica, and maize 50 per cent. magnesia from the soil than potatoes do, and legumes (beans, clover, etc.,) require from 2½ to 13 times as much lime as is required by most root crops such as potatoes, mangels, etc. It follows therefore, that as each crop requires particular substances, either in special quantities, or in some peculiar state of combination, the possibilitiy of the soil being able to supply them is increased, the longer the interval that is allowed to elapse, before the same, or a similar crop, is grown upon it. By alternating the various crops one with the other, the accumulation in the soil of any particuliar substance favourable to the crop it is desired to grow, may be ensured, and the balance of the manurial ingredients in the soil can be maintained for an almost indefinite period.

2. The depth at which roots draw their nourishment from the soil varies with the kind of plant. Cereals, many legumes and some grasses, maize, clover, alfalfa, sugar cane etc., draw much of their sustenance from the subsoil into which their roots penetrate deeply. On the other hand the majority of root crops potatoes, tanias, etc., nourishment from the soluble constituents of the surface soil which have been left more or less untouched by a previous deep-rooted crop. The advantage to be gained from this fact is, that the various layers of the soil can be rested, by alternating a shallow-rooted with a deep-rooted crop.

3. Some varieties of plants which store up certain elements of plant food from the air or soil, are directly restorative to the soil, others are indirectly so, by being fed to the live stock on the land. Chief amongst

the former crops are legumes with their power of storing the nitrogen from the air in the nodules of their roots, thus increasing the nitrogen content of the soil after the crop has been reaped. As nitrogen is the substance which is soonest depleted from a cultivated soil, the importance of a leguminous crop in the course of a rotation cannot be too strongly emphasised. Plants which exert indirect, restorative action on the soil are usually fodder crops, the action being the results of the return to the soil of the manure which has been recovered from the live-stock which have been fed on the crop. The value of such crops does not depend on an immediate cash return, but on the return to the soil in the form of manure of the greater part of the plant food constituents removed by the crop, on the saving in the cost of feeding the live-stock used for cultivating the land or which are raised for sale, and, in the latter case, on the subsequent sale of stock.

Either a root-crop, mangels, potatoes, turnips, etc., or a leguminous crop, peas, beans, clover, etc., may be grown as a fodder crop. The former known as fallow, or cleaning crop, affords the opportunity which has not occurred during the several years the land has been occupied by other crops aften of an exhausting nature, to plough deeply, stir and thoroughly clean the land. Further benefits are derived from the large amount of organic material at once returned to the soil in the leaves etc., the large amount of food produced, and the richness of the manure obtained from animals fed on roots, from which they return only a small proportion of the most important manurial constituents. Legumes may be classified as restorative crops, on account of their power of adding nitrogen to the soil, which when ploughed in green, they also enrich with organic matter, in addition, they provide, in peas and beans, a concentrated, and in hay from clover, lucerne etc., a bulky stock feed, and the soil reaps the benefit from the animal droppings when stock is grazed on the land.

4. The value of the crop residue, differs with the kind of crop. Legumes and grasses yield the most and are richest in ferrtilising constituents ; cereals, while leaving a large residue are poorer in these constituents, and root

crops yield the least. As this residue is the chief source of humus in cultivated soils, it is important that the nature of the crop in this respect should be considered when allotting it a place in the rotation.

5. The insects, fungi, and bacteria which attack plants vary with the kind of plant. Under natural conditions, owing to the diversity of plants contained in a given area, a certain balance is maintained between the plants and the pests insect, fungoid, or bacterial, by which they are liable to be invested. On land under cultivation of plants of the same variety, this balance is more or less upset, by the massing together on the same land providing a ready food supply or host for any insect, or disease peculiar to that variety of crop; further opoprtunity for the rapid increase of the pest is given, when the same crop is grown continuously on the same land. Variation of the crop cuts off the food supply of the pest infesting that particular crop and it either dies out or migrates elsewhere in search of food. It is evident therefore, that in order to ensure some measure of control over plant diseases and insect pests, two crops of of the same species should never be planted in succession.

6. A definite relationship exists between the kind of plant and the kind of soil. The preference shown by each variety of plant for a particular type of soil is evidenced in the natural forests and the secondary bush growth visible around us. Cedar and cypress will grow on dry rocky hillside where hard timber trees such as balata and poui refuse to grow; on abandoned fields of clay, clay loam, loamy or sandy loam soils, secondry growth of guava, black, sage, wild indigo, etc., appear in accordance with the type of soil especially suited to them, and on the margin of water courses, in wet or swampy soils, water cress, lilies, or succulent sappy grasses abound.

In like manner cultivated crops show a preference for certain types of soil; maize, guinea corn, ground nuts, thrive best on well drained sandy loam, rice in a loam overlaying a stiff impervious clay, sugar cane in almost any soil containing lime, but best in rich porous clays, alluvial soils on low lands traversed by rivers, and loams formed

by the decomposition of volcanic rocks, and most root crops yams, tanias, sweet potatoes, etc., in a friable loam rich in organic matter.

This affinity between plant and soil, is principally due to the differences which exist in the physical properties and the chemical constituents of the soil ; by means of tillage, the agriculturist modifies these differences, so that he is enabled to raise crops on soils, which, previous to his efforts, were apparently unsuited to their growth ; in attaining this end he is very materially assisted, both from a mechanical and hemical standpoint, by a judiciously arranged rotation, mechanically, by the changes created in the texture of the soil, oowing to the preparation it has recieved year by year for the different crops, and by its more porous condition caused by the rotted roots of these crops especially the deep-rooted ones, and chemically, by the exposure to the action of the atmosphere of the dormant constituents of the soil which are yearly turned up thereby rendering them active and soluble and increasing the amount available for succeeding crops, and by the admission of water and air into the soil through the channels made by the decaying roots of previous crops, thus enabling the atmostphere to exert the same beneficial influence even in the sub-soil.

7. Plants naturally alternate with each other in the same soil. Evidence that a natural rotation does occur amongst plants is met with in many countries ; burnt pine forests in Sweden are replaced, for a time by birch, which however, is ultimately superseded by a regrowth of the pine ; along the banks of the Rhine, beech is gradually taking the place of the ancient forests of oak, and both are in some cases succeeded by pine ; ancient oak woods are followed by pine in the Palatinate, and in Bohemia pine alternates with beech.

It is believed that these changes of vegetation are largely dependent on the chemical composition and physical properties of the soil, and therefore that plants grow spontaneously where their needs in these respects, can be most fully and easily supplied, the opportunity being afforded to the seeds of other species of plants, lying dormant in the soil, to spring up, whenever natural causes

produce such changes in reference to their access to light, heat, etc., or in the texture and composition of the soil, as to render conditions more favourable to their growth than to that of the plant which already occupies the land.

It is justifiable to conclude, from these facts, that artificial rotation of crops, as has been already noted with regard to shifting agriculture, only follows nature, butthat the former, in distinction to the latter, hastens the operation of nature, by taking advantage of the conditions known to be essential to the successful growth of each crop.

It is evident therefore, that the success of a rotation depends on utilsing these well established facts for the benefit of the various crops which comprise it, but simple as this may appear in theory, in practice many other factors, such as markets, transport, cost of production etc., arise, which renders it impossible to lay down any definite rules suitable to all conditions, nor is it the aim of those notes to attempt to do so, but only to indicate ths general lines upon which any system of rotation of crops should be based. Unfortunately very little attention has been given to this subject in the West Indies, so that it is necessary to turn elsewhere for a basis from which to start, I venture to suggest that none better can be found than the well known Norfolk, or four course rotation, which is in fact the foundation of all rotation systems in England.

This rotation is as follows :—

First year : Autumn sown cereal, wheat,—following clover.

Second year : Fallow crop, roots, mangels, turnips, potatoes, etc.,—cleaning crop, after three years cropping. two crops of which have been exhausting cereal crops.

Third year : Spring sown cereal, barley, oats—following a cleaning crop.

Fourth year : leguminous crop, clover, peas, beans,—restorative crop should follow an exhausting crop.

Before attempting to adopt this system to our local onditions it is necessary to determine the special points with regard to climate, soil and crops, which may be considered to have a general application. These, in their order of importation, may be briefly stated as follows :—

1st. The rapid loss of humus to which all our cultivated soils are liable.

2nd. The practically continuous growth of weeds and grasses which invest all our soils.

3rd. The excessive erosion and leaching caused by the heavy rainfall during certain seasons.

4th. The length of time our major or staple crop occupies the land.

1.—The first can be practically corrected by turning under all crop residue, weed, etc., more fully by the application of long or fresh manure, and still more effectively by the adoption of crop rotation, into which a crop is introduced which extracts from the soil only a small proportion of the necessary plant food substances in the portion taken off the land, while the residue left on the land contains the constituents most desirable for succeeding crops.

2. A proper classification, and a more extended knowlength of the life history of the grasses and weeds most commonly met with on our cultivated lands, is necessary before any really effective method of weed control can be undertaken. With our present knowledge the possibility is very remote of thoroughly cleaning land, so that the majority of the weeds are killed before the crop is planted. We are therefore driven to the necessity of suppressing them while the crop is growing; cleaning crops as used in temperate climates, are therefore of little value to the large estate, but may be used with some success by the peasant proprietor and cane farmers: the use of cover crops to smother weeds is under trial at present, and, although few that have been tried have as yet filled all the requirements of a really effective cover, appear to offer at least a partial solution of the difficulty.

3. The heavy falls of rain to which we are subject in these latitudes, are responsible for erosion on mountain sides and undulating land, and leaching on flat lands. Erosion can be prevented to a great extent, by not allowing the bare surface of the land to be exposed to the direct action of the rain, and by keeping the soil in a porous condition, so that the rain sinks in quickly instead of flowing

over the surface and washing the rich surface soil into the drains and ravines; deep-rooted crops, besides effectively covering the ground, lend material aid in opening up the soil with their roots, and, should therefore always find a place in a rotation.

4. Sugar cane, our staple crop, occupies the land for $2\frac{1}{2}$ to 5 or more years, according to the number of times it is ratooned. The drain on the soil, caused by cropping it to one crop for such a lengthy period, is undoubtedly very great, and the problem of maintaining its fertility becomes more acute year by year, the crop residue of leaves and tops adds a fair amount of humus to the soil, but the amount of plant food constituents carried off by the canes is considerable ; under present methods of cultivation part of this is returned in the pen manure applied to plant canes and subsequently augmented by fertilizers applied to the ratoons. It is a question worthy of the serious consideration of planters, whether a well-chosen rotation crop capable of adding large quantities of humus to the soil, would not ensure an increase in average crop yields by maintaining soil fertility at a higher level, and by the control, which a change of crop would effect, of the insect pests and diseases, notably froghoppers, by which this crop is liable to be attacked.

Any attempt to indicate the crops that should be utilised in a rotation, in this colony, must be considered from the separate view points of the large estate owner, and the cane farmer or peasant proprietor as each is confronted by different problems. To the former it is largely one of labour and markets, to the latter of remunerative crops. Lack of capital preventing him from planting any crop that will not yield an immediate cash return, in either case, only the variety of crop can be suggested, the specific crop must be determined by each individual according to his particular needs.

Dealing first with the large sugar cane estate, it will be helpful to analyse the Norfolk rotation, when it will be seen that it consists of two cereal crops, which are directly remunerative, but exhausting to the soil as the entire crop is usually removed from the land, and two crops which are

not directly remunerative as they are usually fodder crops fed to live stock on the farm. Both add humus to the soil, one the root or cleaning crop, leaves the land free of weeds after the crop is reaped. It is also shallow rooted and therefore allows plant food to accumulate in the sub-soil, and the other a leguminous or restorative crop adds nitrogen to the soil and being deep-rooted helps to increase the plant food constituents in the subsoil.

The order in which these crops are planted shows how they inter-act upon each other ; exhausting crops, wheat, barley, oats, are followed either by a cleaning crop, roots, or a restorative crop, legumes, and these in turn are followed by exhausting crops.

A sugar cane occupies the land for an average of 3½ years, it should be followed by a restorative crop, to be replaced by a cleaning crop, followed in turn by a cover crop before cane is planted again.

In Barbados, after the land has been under cane for 6 or 7 years a change of crop for a short period is often practised. This very modified two-course rotation leaves the land free from cane for 7—19 months as follows :—

After cane has been thrown out after crop, a fodder crop of Imphi is planted in April—June, cut 4 to 5 times and fed to the stock, in November of the following year, about 17—19 months later the land is replanted in sugar cane.

Or, sweet potatoes, cassava, or cotton are planted in September—October, reaped between January and February and the land with a catch crop of yams or eddoes in November replanted in cane, only seven months having elapsed since the land was last in canes.

If the soil shows signs of deterioration, a restorative crop of woolly pyrol, pigeon peas, or increase peas is planted between April and June and used as a green dressing before canes are again planted in November of the same year.

As a rotation this appears to lack completeness, the long period of 7 years under cane, followed by only 7—19 months rest under a change crop, seems capable of improvement ; with considerable diffidence, the following is sug-

gested as more likely to enrich the soil with humus and other ingredients, within the short period of 18 months, provided the cane has been allowed to occupy the land for only 3 or 4 years.

FOLLOWING THE CANES.

1. A short or medium period cover crop, sun hemp, canavalia, pigeon peas, etc., planted in May—June cut down and turned in to the soil in September to October

2. Food or fodder crop. Sweet potatoes or corn, etc., planted in September—October, reaped in January to February,

3. Restorative crop. Pigeon peas, Bengal beans, or *crotolaria striata*, etc., planted in May—June, ploughed into the soil in October.

4. Canes planted in October. Or as an alternative :—

1. Restorative crop. *Tephrosia candida*, Bengal beans, pigeon peas, or *crotolaria striata*, etc., planted in May—June, and turned under in March—April.

2. Food or fodder crop. Yams, sweet potatoes, or corn, planted in May—June, reaped in September—October, Yams in January.

3. Short period cover crop. Sun hemp, canavalia, or Wooly pyrol, planted in October—November and turned under in January—February.

4. Canes, crop or spring planting, April—June.

It will be noted that this rotation attempts to establish some control over weeds by providing two smother crops, the first and third, both of which being leguminous crops and deep-rooted, are also restorative, and and, the second, a food crop that may be sold, or a fodder crop that may be fed to the stock.

The possibility of carrying out such a rotation on a large scale will depend chiefly on the cost, and can only be determind by tentative experiments to ascertain whether any increase, if any, over the present system of cultivation, will be more than compensated for by the improved soil conditions and control of pest, leading to a higher level of average crop yield.

I am indebted to Mr. G. A. Jones, Agromonist of the Ste. Madeleine Sugar Co. Ltd. for the following

rotation and its results, which was started by him in 1919, as a demonstration plot for the cane farmers of this company.

The plot aproximately three acres in extent, is divided into six sections of about equal size, four of these are under cane, viz., plant canes, 1st, 2nd, and 3rd ratoons respectively, one is planted in root crops, yams and cassava and the last in peas, to be followed by sweet potatoes and young cane plants. The work of the plot is done by one man working all the year round, but with time at his disposal to work as an ordinary labourer on neighbouring estates.

The effect of this system is that:—

1. Every four or five years the land is rested from cane or eighteen months.

2. The soil is thoroughly cultivated by the growing of root crops for eighteen months.

3. Each section receives an application of pen manure at the rate of twenty tons per acre every six years.

4. A steady tonnage of cane year by year is maintained, varied only by factors beyond control.

5. The farmer is provided with vegetables for his own use, the surplus being available for sale.

The results of this rotation are encouraging. the yield for the seven crops reaped from the two acres of canes, has varied from 18.5 to 30.8 tons per acre, disclosing an average yield of 25.75 tons per acre per year, the lowest yield being for this year's crop, which is no doubt a reflection of the previous year's drought. The financial returns are equally satisfatory, the first crop cost $218.80 to cultivate, the profit of $149.85, and the average year-gross receipts were $360.65. Assuming that the farmer performs all the necessary work without assistance, working 152 days a year, this provides him with a wage of 80c. a day, a very fair daily wage for an ordinary agricultural labourer.

The peasant proprietor usually plants all his land in one permanent crop, Cocoa, which leaves no scope for any rotation, the unwidsom of this is apparent when yields are poor and prices depressed, he would be well advised to leave a portion of his land for planting short crops to provide food for his own use and for sale; the practice of

mixed cultivation should also be abandoned, and a system of rotation substituted, following along the same lines as that of the cane farmer's rotation and substituting plantain and bananas for canes, 1½ acres divided into ¼-acre plots might be rotated as follows:

Four plots to be cultivated in plantain and bananas viz., young plants, 1st, 2nd, and 3rd crops respectively, the remaining two plots being alternately planted in cereals, root, and leguminous crops for 1½ to 2 years. It is unnecessary to enumerate these crops as they will vary with the soil and district.

The objects to be attained by this rotation are obvious; After three or four years under bananas the soil is rested for about two years, during which it is kept clean and its texture improved by the planting of root crops, its chemical constituents are added to by the deep-rooted leguminous crops, and organic matter is obtained from the residue of both crops. Good results will be better assured, if the peasant proprietor keeps some small stock such as a donkey, pig, goats etc., in order to obtain manure and use up surplus and unsaleable portions of his crops.

GERMINATING SUGAR CANE.

By D. W. May.

Porto Rico Agricultural Experiment Station.

With all plants a quick germination is important. They emerge from the soil with larger shoots and apparently greater vigour if they spring quickly after planting. This is especially true of sugar cane where the growth is sometimes limited by season or by well-distributed rainfall. If after a crop is planted germination languishes, it is generally due to some poor condition in the soil or lack of water.

Various methods have been used to bring about quicker germination in cane cuttings. Soaking seed in solutions is often practised, water being the most common. There are several products on the market for stimulating seed which are sold under various trade names.

In a series of experiments by the Porto Rico Experiment Station some interesting results have been obtained which should result in considerable benefit to the sugar industry. These experiments were made with two objects in view: first, to obtain a quicker and more vigorous germination of the cuttings and, second, the killing of certain insects affecting the seed, especially the cane borer (*Diatraea saccharalis*). The canes were soaked in solutions from 1 to 8 days. The good effects were apparent in one day, while the length of 8 days was detrimental and in some solutions the cane was killed. Two days was sufficient to gain the ultimate benefit from soaking, and in no case proved detrimental, while good results were possible in one day. In the case of some solutions the cane was killed even at one day.

The solutions giving the best results were water alone, lime, and lime and magnesia, soaking one day. Solutions of nitrogenous fertilizer proved of no advantage and in one case resulted in killing the cane. Soaking in water has this advantage aside from its influence in killing insects,

that the canes germinate quicker and make a greater ultimate growth than where they are planted not soaked. In some cases where planting was followed by a long drought, the soaked canes had sprouted and made a good stand, while those not soaked in many cases failed to germinate. In all cases there was a marked difference in the stand between the soaked and unsoaked canes and also in the continued growth and final yield. In soaking in limewater there was an apparent favourable condition in the earliness of germination, quicker growth and yield over the canes soaked in water alone. There was a still greater percentage of germination, growth, and yield in the cane soaked in the solution of lime and magnesia combined. In the final yield of cane treated in the manner set forth above, the cane planted as cut gave a germination of 81·41 per cent., soaked in water 86·42 per cent., and in limewater 93·03 per cent. The final yields of a series of plants were estimated as follows: Cane planted without treatment, 58·7 tons per acre; soaked in water, 71·9 tons per acre; soaked in limewater, 72·5 tons per acre; soaked in limewater containing lime to saturation and 1 pound of magnesium sulphate to 50 gallons, 85·4 tons per acre.

In preparing the canes for planting the work was done on a large scale, which can be economically followed by planters. The saturated solution of limewater was made by shovelling slaked lime into the tank. The saturated solution of lime and water is 0·13 per cent. What remains over in the tank undissolved does no harm. Magnesia was added in the form of sulphate at the rate of 1 pound to 50 gallons of water. Repeated treatments have shown consistent favorable results with the combination of lime and magnesia in the water in which the cane cuttings were soaked. Also favorable results have been obtained in soaking cuttings of various plants with the object of precipitating a quicker sprouting and rooting and securing a higher percentage of growth.

The role played by lime and magnesia in plant production has been studied by Loew, and some interesting results developed by him. The writer, in collaboration with Loew, carried out some experiments in the employ-

ment of these two elements in the growth of various plants. The results were published in Bulletin No. 1, Bureau of Plant Industry, U. S. Department of Agriculture, under the title "Relation of Lime and Magnesia to Plant Growth." Anyone interested in the subject and especially the more detailed results and the theoretical explanation of the action of these elements can obtain such information from the perusal of that bulletin. Suffice to say that the influence of lime on plant growth is a matter well known in agriculture—one of the first points noted and established when man undertook to determine what affected most the production of plants and crops. The relation of magnesia to the growth of plants has been a subject of more recent study; however, the fact that this element is present in increasingly large amounts in mature seed indicates that it is there for some purpose and one that has to do with the early development of the growing seedlings.

As the experiments outlined in this article can be followed in field practice at such a moderate cost, while the indicated results are so favourable, a trial under field conditions is urged upon all cane growers. The gain indicated is threefold: First, insecticidal, the elimination of the cane borer; second, irrigation, practically the early watering of the cane; third, yield, quicker growth and larger tonnage.

FISH MEAL

Extract from Report of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs produced within the Empire (Fish Report—Fish).

Since the War a very important development has taken place of great value to the fishing industry, as opening a large and expanding market for the use of its waste material, and of great value also to the agricultural industry in the feeding of stock and poultry. The use of fish meal as a feeding stuff to cattle is comparatively new in Great Britain. It started a little before the War, was developed during the War—when there was a shortage of feeding stuffs—and has now become an accepted part of agricultural practice. "White-fish meal" of the kind and quality which should be used for feeding to animals, contains from 55 per cent. to 60 per cent. of protein and about 15 per cent. to 20 per cent. of phosphate of lime. It is thus a food very rich in protein and contains also a necessary mineral constitutent often deficient in other feeding stuffs. Its value does not, however, depend merely on the high percentages of these constitutents. The question has not been as yet completely elucidated, but it may be surmised that the form in which protein occurs in fish meal is one which is particularly useful in aiding the animal to assimilate other proteins which it receives in its grain foods. It is known that maize protein by itself is not effective in building up flesh tissues, but the addition of fish meal in comparatively small quantities to the cereal proteins may be an important aid in the formation of these tissues. Fish meal appears to possess a special virtue as a feeding stuff above that indicated by its chemical analysis.

The phosphate of lime and other mineral constitutents in which fish meal is rich, are also of great value—even necessary—in a ration for young growing animals especially, as the cereals on which pigs and poultry are so largely fed are deficient in salts of lime. It has further

been argued that fish meal owes some of its accessory value to its vitamin content, but on this point the evidence is not conclusive.

Fish meal has proved very useful for growing stock of all kinds, for milking cows and for egg-laying poultry. As it is a highly concentrated food it should always be given in limited quantities and in conjunction with other foodstuffs, and the prejudice which exists against it in some quarters is probably due to the neglect of these precautions. Thus, in feeding poultry, the English Ministry of Agriculture and Fisheries recommend a mixture of the following nature for chickens over a week old :—

Parts by Weight:

4 Sussex Ground Oats.
4 Middlings,
1 Maize Meal.
½ Fish Meal.

The proportion of fish meal may be increased gradually as the birds grow, until 10 per cent. to 15 per cent. by weight of the mash given to adult birds in times of heavy egg production may advantageously consist of fish meal. Five per cent. by weight of the day ration is a suitable proportion in the food of pigs between the time of weaning and slaughter ; whilst, for cows and heifers in milk, a little less than one lb. per day per animal would be appropriate.

A strong opposition to the use of fish meal in the feeding of pigs has been urged by all sections of the bacon and pork trade, who complain that thereby the flesh is liable to be tainted with a fishy taste or odour. Exhaustive attempts to produce tainted flesh at various research stations by heavy feeding of "wholesome" white fish meal have completely failed, and many large producers are known to use fish meal regularly without ill effects. Nevertheless the trade objection to fish meal should not and cannot be overlooked. There is no danger of such results, if good white fish meal is used in the quantities which the English Ministry of Agriculture and Fisheries

advise. The farmer when fattening pigs for market can, however, adopt a further precaution. Fish meal is of special benefit whilst an animal is growing or is heavily producing milk or eggs. It is of less value in the final stages of finishing for market. The pig fattener, therefore, can well cease feeding fish meal to his pigs a month before they should be ready for slaughtering and by doing so, all risk of taint, if good meal is used, will be avoided.

Other complaints of "taint" have not been so pronounced as those from the bacon and pork butchers. A certain mumber have been made in regard to milk, but they have been comparatively few and, it is believed, that the taint was probably due to absorption by the freshly drawn milk of the flavour of some stocks of fish meal or fish fertilizer in the vicinity of which it had accidentally been left. It is certain that none of the agricultural research stations have been able to induce a fishy taint in milk through feeding wholesome white fish meal to cows.

The risk of taint, which does arise in using fish meal for feeding, is due to the use in immoderate quantities of low-grade meals with high oil content. Nearly all the manufacturers in Great Britain have agreed to produce a meal from white fish only (without herrings or other unsuitable material) to be sold as "White Fish Meal" and conforming to the following limits of composition :—

	Per cent.
Aluminoids : Not less than	55
Phosphate of Lime : Not less than ...	16
Oil : Not more than...	5
Salt: Not more than...	4

The Fertilisers and Feeding Stuffs Act, 1926, which has not yet come into operation, requires sellers of feeding fish meal to give each purchaser a written warrantry as to the percentage content of protein, phosphoric acid, oil and salt, respectively, and also contains definitions of both "fish meal" and "white fish meal." These definitions and the particulars to be given with regard to composition may be varied by regulations made jointly by the Minister of Agriculture and Fisheries, and the Board of Agriculture

for Scotland after consultation with a Committee which has been set up to advise on matters arising out of the Act.

Experiments have not been sufficiently far pursued to determine whether and under what conditions herring meal may be similarly used as a feeding stuff without objection. In the herring, the oil is more widely distributed through the muscles of the fish ; the oil is of a different kind and carries certain strongly smelling substances over into the fat of the animal consuming the fish meal, hence the "taint."

It is not necessary to consider whether herring fish meal can be used as a food, since it posesses an outlet of little less value for use as a fertiliser, and so should command a good sale where intensive cultivation is practised, as, for instance in hop gardens. The extent of its use is a matter of comparative price with that of other organic nitrogenous manures.

The total output of fish meal in Great Britain in 1925 was about 40,000 tons, of which 8,000 tons were herring meal. The greater portion of the production of white fish meal is exported to Germany, which country, generally, imports comes in as a strong buyer in the autumn. The total imports of fish meal into Germany from all sources in 1926 was 82,000 tons as compared with 46,000 tons in the previous year. It is calculated that in 1926 some 50,000 tons out of these imports of all kinds of fish meal were used in Germany as feeding stuffs.

The English Ministry of Agriculture and Fisheries have supplied us with an estimate of the extreme limits to the quantity of fish meal, which might be used in Great Britain, if all owners of pigs, cows and poultry gave it to their stock in the proportions recommended by the Ministry. If this were to happen, 400,000 tons of fish meal would be required annually. This is a figure far in excess either of the probable demand or of the possible amount of fish meal obtainable from the quantities of fish now landed. It is sufficient, however, to show that a wide potential market for fish meal exist. If its use became more general there should be, in Great Britain, a market for all the wholesome fish meal which could be made from the fish waste resulting from the British landings of fish.

One limiting factor which we have not so far mentioned is price. As a concentrated feeding stuff, white fish meal is in competition with various oil cakes, and there is a limit beyond which farmers will not go in paying for the special attributes of fish meal, which at present is very expensive as compared with cotton, linseed and groundnut cakes. Lower prices are needed for wider demand but the the fish meal manufacturers explain that Germany is always ready to outbid the British purchaser for British meal.

We have dealt at large with fish meal as a food for stock because it appears to us that the efficient treatment of the by-products of the fisheries—fish meal and oil—should have some effect, at any rate, in reducing the cost of fish sold for human food. Such a development can only be obtained by proper organisation whereby all waste material is separated and dealt with at the ports if not in a factory ship. Plentiful supplies of good white fish meal at reasonable prices would also subserve the purpose of producing meat, milk and eggs. This is true of Great Britain. It is equally true of Canada, Newfoundland, and of any part of the Empire which is developing its fisheries. We would direct the particular attention of those Governments of the Empire, whose territories are known to be deficient in phosphates to the advantages of the addition of fish meal to the ration of cows, pigs and poultry. It appears to us that a very important advantage, which would accrue to Australia and South Africa from the organised development of their fisheiries, would be the provision of this fish food and fish ferti liser for use in places in which intensive agriculture is practised.

AN AFTERNOON WITH THE HONEY-BEE.

An address delivered by Revd. C. D. Lalla, President, Bee-Keepers' Association, at a general meeting of the Agricultural Society of Trinidad and Tobago, held on the 14th July, 1927.

The time honoured adage—"Necessity is the mother of invention," will once more appeal to us, as it did on the occasion of the world-war. On that occasion we learnt the dire experience, that our sugar and cocoa upon which we had all along depended, could not be expected to provide the necessaries of life, but that for these essentials, we looked forward to other countries, from which we were in a measure isolated by the submarine menace. There was apparently no other alternative before us then, but to revert to Mother Earth for the solution of our pressing economic problem. Agriculture was the popular medium, and Ground Provisions the timely outcome. Government Depôts for our Ground Provisions and Fruits were later developments, calculated to provide a ready market for our surplus productions and determine their judicious distribution among the various centres of our Island.

After the termination of that great war, normal conditions gradually returned affording on the one hand a most welcome relief, and resulting on the other in a consequent slackening of the war time activities. In order to correct the apparent manifestation of our economic lethargy, it would seem as though Providence, the Great Teacher had once more opened school. His method seems to have been a repetition of the war time necessity, precipitated quite recently by the unusual severity of successive dry seasons and the island-wide devastation by Froghopper Pests—the one seriously threatening the very existence of Cocoa, and the other of the Sugar Cane Industry, thereby throwing us back once more over on the lap of Mother Earth for a possible relief from the threatening gloom, which had again overtaken us. The promising outcome on this occasion has been the establishment of the Fruit Industry contem-

poraneous with the Fruit Growers' Association. To add one more string to our economic bow and provide another equally promising field of usefulness, you have been asked to spend—" An Afternoon with the Honey-Bee."

I.—Every Planter a Bee-Man.

The question might be reasonably asked—what has The Agricultural Society to do with Bee-Culture? The answer is that Bee-Culture is intimately related to Agriculture, and that every Planter is a Bee-Man, if not consciously, then unconsciously at any rate. It would seem that this was the identical view entertained by The Imperial Department of Agriculture, for in the year 1901, Sir Daniel Morris, the then Commissioner of Agriculture for the West Indies, actually engaged the services of a bee-expert in the person of Mr. W. K. Morrison, of the United States Department of Agriculture, who subsequently visited the West Indies at the expense of the Government, and in a degree modernised the West Indian Bee Industry. Coming nearer home, it is no secret, that our Director of Agriculture, The Hon. Professor Freeman, and his ever enterprising Entomologist, viz., Mr. F. W. Urich, were mainly instrumental along with others in founding the Trinidad and Tobago Bee-Keepers' Association, of which Sir Francis Watts, President of The Agricultural Society and Principal Emeritus of The Imperial College of Tropical Agriculture, is its venerable patron.

How?

Some of us might be inclined to say this is all well and very good, but tell us how? To provide an answer to this question is unquestionably the burden of our address, and we will do so by reviewing the relationship that exists between the Planter and his Plant.

As practical Planters our great concern is to adopt the best possible tillage of our fields. with the hope of reaping therefrom the largest possible crop, and with the least possible outlay. The cane planter has an eye to his largest tonnage and the cocoa proprietor to his highest fanega. The former does not only manufacture sugar and its bye-products, but also utilizes the very megass to advantage.

The latter also reaps his cocoa and even sells the cocoa-chaff or pascillos to those who usually cater for the wants of our labour community. It is manifestly clear, that every known element of usefulness in the industry is taken full advantage of and made to contribute its own "bit" to the ultimate success of the enterprise. We make use of the term "*known*" element of usefulness advisedly, because it is just possible, that with the establishment of The Imperial College of Tropical Agriculture and the progress of scientific research as undertaken in our midst, other equally useful elements hitherto unknown to us may yet appear on the planters' horizon, and of a character he lpful to the cause, which he carries seriously at heart. A t this juncture, we can conscientiously assert—and without the slighest fear of contradiction, that there is one such new-field unexplored by our wide-awake planters, and which is equally capable of augmenting his exchequer to the same extent—if not exceeding those derived from bye-products, which already engage his attention. It is the privilege and honour of The Trinidad and Tobago Bee-Keepers' Association to point out by practical demonstration and otherwise, that hitherto unknown field to you.

II. PLANTERS' OMISSION HONEY BEES' SPHERE.

The roots and stems of plants provide fuel, the leaves material for mulch, the fruits and their bye-products add to the planters' bank account, but why are *flowers* excluded from the sphere of practical operation? But for this outstanding omission, the Planters' exploration of our premier industries would have been both complete and thorough. It is somewhat significant to note, that the usefulness derived from roots, stems, leaves and fruit is most carefully and scrupulously utilised, that from flowers still remains unexplored and thus go a waste. While this signal omission is apparently attributable to the p.anting community, it does not by any means exclude those concerned with Floriculture, and particularly applying to those of us, who have been greatly impressed with the recent claims of the Fruit Industry and the inviting field it offers. At least the range of the question embodies all Agriculturists, Horticulturists, and Floriculturists, who it would seem, that

hitherto apart from admiring the delightful flowers, actually despised and neglected their potential value. Here again it would appear as though Nature has provided this wonderful insect to explore the field thus unconsciously overlooked by us. If the wasted resources that lie embedded in the flowers were as judiciously taken advantage of, as in the case of kindred industries, there is absolutely no doubt but that, in the immediate future there be opened up to us and our posterity another avenue of usefulness and unquestionably the most interesting, the most instuctive, and the the most profitable of all the minor industries known to plantocracy. The question may next arise how can this be achieved? The answer is through the agency of the Honey-Bee.

III.—Honey-Bees—The Planter's Friend.

It would be interesting at this stage to briefly survey the three-fold service, such as the industrious bees have been rendering to mankind from time immemorial, viz :—

(a) They facilitate the process of effective pollination, thereby improving the quality and quantity of our fruits.

(b) They extract the nectar from flowers and convert it into delicious honey, thereby transforming waste material into a profitable article.

(c) They manufacture Honey Comb from floral ingredients from which Bees Wax is made, and which, if utilized, would convert waste material to advantage.

Under the circumstances, it should be readily conceeded that the silent but extremely useful Bee deserves at our hands more than a passing reference, therefore a brief account of its Life-History may now prove both interesting and helpful.

IV.—The Life History.

1. The Home. The box in which Honey Bees are kept is called a hive. There are two kinds of hives in local use, viz. :—(a) local make, and (b) imported. The cost of the former is low, but that of the latter although high, is more convenient and durable.

2. The Colony. The inmates or colony of bees which dwell in a hive consist of three classes of bees viz :—

(a) The Queen. As her name indicates, she is the supreme object of veneration in the hive, both on account of her high rank, as also from the fact that she is actually the mother of her colony. It takes from 10—15 days to rear a queen. About a week after her birth, she embarks on her wedding flight meeting her partner in mid-air, where the union is effected. A few days later, she enters upon active service and steadily adds to the numerical strength and effectiveness of her colony. She has the capacity to lay from about 1,000—5,000 eggs daily, mating only once in her life-time. Her span of life is about five years. She has a sting but seldom has occasion to use it—her sphere of influence being indoors. She is the largest bee in the hive.

(b) The Drones. The drones are the male-bees and their sole function is of a paternal character. Apart from serving as a mate to the virgin queen on the occasion of her wedding flight, they serve no other useful purpose, and their presence in large numbers in the hive is a serious menace to the honey-store. It takes from 20—24 days to rear a drone and their span of life ranges from about 2—3 months. They possess no sting and are therefore perfectly harmless. The drones are somewhat smaller than the queen, but larger than the workers.

(c) The Workers. As their name indicates, the workers go far afield so as to provide the necessaries of life for the entire colony, as well as perform the various duties within the hive. They require from 18—21 days to be reared and live for a period hardly exceeding Three Months. As their duties require them to venture far and wide, they are specially armed

with a formidable sting, and know the art of manipulating it to advantage when disturbed in the performance of their daily vocation. The various services to which they are invariably commissioned are as follows :—

(1) Field-Workers. These daily go out to the fields, in season and out of season, searching the precious elements which go to sustain life.

(2) Sentinels. As their name indicates, their sphere of labour is at the entrance of the hive, when they are expected to challenge any intruder, and if need be, to expel him out-right from the hive.

(3) Attendants. These usually wait on the royal mother-queen, and thus facilitate her in her most important work within the hive.

(4) Nurses. These look after the care and nourishment of the young broods.

The workers are the tiniest bees in the hive but they play a very important part indeed. A word or two will next follow with regard to their culture.

V.—The Culture.

Any one desirous of embarking on the Bee-Industry may do so in one of two ways, viz :—

(a) The Nucleus Method. A nucleus is a baby hive, possessing all the elements, that would in time develop into a complete hive. A nucleus is usually placed in a box of from 3—5 frames. For a beginner or novice this method is specially recommended, because during the transition a decided gain in knowledge and experience will result therefrom. The approximate cost of a 3—5 farmers' nucleus of Italian Bees is from three to five dollars, which the bees can repay in a single season, and even leaving an appreciable surplus in the hands of the enterprising novice.

(b) The Hive Method. A complete hive possesses all the elements capable of gathering honey

from the every start. The manipulation of a complete hive will require some knowledge and experience on the part of the Bee-man or Apiarist. A general idea can be obtained by a perusal of any good bee-book, but as most books were written by men unacquainted with Tropical Bee-Culture, their recommendations often prove impracticable to us out here. Practical experience will be realised by any intelligent beginner if he has patience and an observant eye. The cost of a complete hive will vary from \$5—\$25. The price is usually determined by the strain of the bees sold, the strength of the hive, and its honey-producing capacity.

Whatever the initial outlay, the proceeds of the very first crop will more than repay it in full, and at the same time leave a fair margin on the right side. In view of these interesting statements one would naturally be curious to know something about Bee-Productions.

VI.—The Productions.

An exceptionally strong bee-hive should produce, all things being equal, two gallons of extracted honey and ½ lb. of bees-wax every third week during crop time. There are about ten extractions for each season, and that an "A-1" hive should be capable of yielding about 20 gallons or 300 lbs. of honey and 5 lbs. of bees-wax per season. Under ordinary circumstances, however, an average hive would hardly exceed half the above yield. The honey season begins from the month of October and ends in June, so that the crop lasts for about nine months. In some localities the honey flow is greater than in others, and consequently the yield varies according to the nature of the honey-flow and the extent of bee-plants in existence. A bad honey crop results from a severe drought as well as from excessive rain, as has been the case this very year. The best crop is reaped when the season is normal. As it obtains with cocoa and sugar, so there is with honey also "a good and a bad crop," but unlike the former an adverse crop in Bee-culture is hardly attendant with any pecuniary loss. After the initial expenses have been met, a skilful and enterpris-

ing Apiarist usually reckons by the profit column of his ledger. All he has to do is to occasionally but systematically supervise the hive, and the industrious bee does the rest. A honey-producing tree or bee-plant contains in its blossoms a sweet liquid, which is called nectar, from which alone the bees make honey. Honey produced by any other process is impure or adulterated honey, and the person committing such an offence is liable to incur a heavy penalty in Europe and America. Let us hope that our own government will also give us some day a like protection. The estates and forests of Trinidad and Tobago abound with bee-plants, and from a casual observation, it would appear as though fully 99% of our trees—cultivated or otherwise come within that category. The colour of honey is determined by the colour of the blossoms from which it was obtained by the bees. The light and medium colour honey fetch a higher price in the market than the dark colour liquid. Our honey must be graded, as is done with cocoa, in order to effectively compete with the aritic-le of advanced bee-beepers, who at present monopolise the world's market. The logwood tree, which is the best of all bee-plants, is well adapted to our soil and climate. As is well known, the stems of the logwood trees produce materials for making dye, and the blossoms give the best honey in the world. In this connection it would be extremely interesting to hear what one of the most distinguished bee authorities of the U.S.A. has to say. Messrs. Hooper Brothers of Kingston, Jamaica, on submitting some years ago samples of logwood honey to Mr. A. I. Root of Medina, Ohio, U.S.A., received the following opinion with respect to same :—" In looks it certainly compares favourably with anything we can produce here in America. On breaking the comb we find the honey very thick, of a beautiful crystalline amber ; and when one tastes it, he utters an exclamation of surprise and pleasure—at least I did. Logwood honey is unlike anything else. The flavour is peculiar, suggesting something between violets and geraniums,—at least the honey seems to taste somewhat as violets and geraniums smell ; and yet the distinctive flavour is not strong enough to cause one to tire of it. My im-

pression is, that if this honey were on sale in some of the cities in the U.S.A., and if customers were allowed a taste of it, it would all go off at fancy prices. Not everybody may think as much of it as I do ; but if all logwood honey is like the sample sent us, I predict it will rank side by side with the choicest products of the mountain sage or of the clovers." West Indian honey, therefore, if produced from logwood blossoms, will assuredly take the premier place in the world's markets. The logwood trees can also serve other useful purposes, such as the formation of an excellent hedge, which can be planted in the same way as is the case with hibiscus and cactus hedges. They can also be used to even greater advantage in replacing decayed savannah posts, and being a live post their four-fold value can better be imagined than expressed. The next question arises—what are the various uses to which honey and its bye-products can be put ? An explanation of their possibilities will go a long way in enabling an aspirant to determine its potential value, and if attractive, to launch out on this latest industrial expedition.

VII.—The Possibilities.

The outstanding possibilities of honey and bees-wax are as follows :—

(a) Financially. As has already been stated, the proceeds of an exceptionally strong hive per season is approximately 20 gallons or 300 lbs., which, if sold at the wholesale price of $1.00 per gallon or 15 lbs. would fetch the sum of $20.00. Now add to that 5 lbs. of bees-wax at $1.00 per lb. would yield the sum of $5.00, thereby making a total of $25.00 per hive. This calculation is based on the yield of an excellent crop, and in a locality, where bee-plants simply abound. An average hive, however, would hardly be capable of producing beyond half that amount. If this is the capacity of a single hive, then that of a thousand hives would be a thousand-fold. Therefore it goes without saying, that if the neccesary market is available, the bee-industry is fully capable of

augmenting the planters' exchequer by thousands of dollars.

(b) Domestically. Honey was the common article of diet among ancient people, to whom it served as their principal sweet. It was a table-delicacy of such a high order. that it also formed one of the items sent as a propitiatory gift by Jacob to his unrecognised son Joseph, the chief ruler of Egypt. This, we are informed took place 3,000 years before the first sugar-refinery was built. Honey—unlike sugar, can be stored away for 100 years. and will not suffer the slightest deterioration. but will on the contrary improve with age. Honey is a nutritious food and can be safely taken by both children and adults. It is pre-digested sugar, so that persons with weak stomachs and especially those suffering from diseases in which sugar is forbidden, can take it fearlessly. Milk and Honey are as good a food combination to-day as they were in the days of Canaan. Honey can be used to greater advantage than sugar. especially in making cakes, confectioneries and other table-delicacies. Honey-tea, which is a regular meal in Germany, is prepared from a cup of hot water in which one or two tablespoonsful of honey are diluted. In the opinion of scientists, the attainment of long life has been attributed in certain cases to the life-long use of Honey-tea. Vinegar made from honey is considered to be the best in the world. The high standard of honey-beer and honey-swizzles are well known to people addicted to the drink habit, but healthy folks do not need them and should give them a wide berth.

(c) Medicinally. Bee-sting, which is so much dreaded by beginners is regarded as a sure cure for muscular rheumatism. It is said that French doctors prescribe a mixture of honey and butter for invalids in preference to cod liver

oil. Honey is helpful to those suffering from pulmonary diseases, and anyone feeling distressed from a husky throat, will find a mixture of honey, lime juice, and powdered black-pepper most effective. Even bees-wax is always in demand in the drug stores, where it is utilised in various ways for medicinal purposes. Honey when taken in certain quantities acts as a mild and pleasant aperient.

(d) Educationally. Bee-culture provides the most interesting and instructive nature study in the world, as it helps to instil into youthful minds lessons of industry, frugality, loyalty, co-operation and cleanliness. Modern countries, recognising this great fact, do not only insist upon its inclusion in the schools' curriculum, but also give the industry their whole-hearted support by legislation, subsidy, supervision, and otherwise. We earnestly hope that the day is not far distant, when our local government will also join the radiant circle, and thus identify itself in this, as in other kindred industries, which are destined to promote the progress of this our island-home, as also to add to the economic stability of the population at large.

Gentlemen, this brings the academic part of our reception to a close. I have already occupied your time and attention to a considerable length, and should therefore finally thank you for having given us a fair hearing. If we have even in a small degree impressed you with the poentialities of the Bee-industry, and the advantages dervable to the planting community therefrom, we shall feel amply repaid for the time and labour expended in the preparation of this address in your interest this afternoon.

DEPARTMENTAL NOTES.

DIRECTOR'S ACTIVITIES.

From 8th to 10th August, Professor Dash was in Berbice. He opened the Session of the B.G. Farmers' Conference, gave an address at their evening Session, visited certain cacao and banana cultivations, and obtained some suckers of what he considered to be the true Gros Michel. He also inspected the gardens at Colony House and the local market in New Amsterdam, ending up with a short visit to the Corentyne coast.

He paid two visits to Essequibo during August and October, in connection with the selection of seed padi, visiting most of the larger rice estates on the Coast, and conferring with millers and growers.

The opportunity was also taken to visit Plns. Hampton Court and Anna Regina, as well as the Government Industrial School at Onderneeming. A day was spent in the Pomeroon River visiting coffee and other cultivations and inspecting the agricultural station at Marlborough.

In September he visited the Canals Polder District the upper East Coast, Demerara, and also the small cultivations and holdings at Beterverwagting. A day was occupied up the Mahaicony creek, where he inspected some of the larger rice farms, in the company of Mr. Sampson from Kew. He visited Plns. Diamond, Providence, Uitvlugt, Ogle and Hope, in connexion with cane, coconut, rice, and peanut cultivations, and also rice areas on the West Coast of Demerara.

Several visits have been paid to Pln. Cecilia, to inspect and study the ground-nuts and the work in progress there, in view of its further use by the Department.

In October he also visited Pln. Lusignan in connexion with an outbreak of Sugar-cane Aphids.

Mr. L. D. Cleare, the Government Economic Biologist, visited the county of Berbice between August the 3rd and 8th, accompanying Mr. H. C. Sampson of Kew. Rice cultivations and mills were inspected in the Upper Corentyne District as well as on the West Coast of Berbice in the Fort Wellington—Bush Lot area. The lime cultivation at Pln. Providence was seen while Plns. Blairmont and Bath were also visited.

In August also a visit was made at Pln. Providence, East Bank Demerara, in connexion with Ground Nut Cultivation on that estate.

In September the Mahaica—Mahaicony and the Bartica District, were visited in company with Mr. H. C. Sampson. Three days (6th to 9th) were spent in the Bartica District and the areas inspected included the farms at His Majesty's Penal Settlement, the Agatash Estate grants on the Essequebo River between Macowan Creek and Agatash, the Hills Estate and Kilacoon and a few farms on the lower Mazaruni River.

Pln. Lusignan, East Coast, Demerara, was visited also in September in connexion with an outbreak of Sugar-Cane Aphids.

In October visits were made to Plns. Schoonord, Uitvlugt and Leonora on the West Coast Demerara, and to Pln. Cecilia on the East Coast.

In September, Mr. E. M. Peterkin visited the Pomeroon River and the County of Berbice in company with the Director of Science and Agriculture.

Three visits were made during August, September and October to Essequibo in connection with the selection and purchase of seed padi for distribution (sale) to farmers in other parts of the Colony.

He visited with Mr. Sampson, Plns. Providence and Diamond, E. B. Demerara ; Canal No. 1, W. B. Demerara, and Pln. Uitvlugt, W. C. Demerara ; and Plns. Ogle and Hope, E. C. Demerara. He also visited rice cultivations in the Mahaica-Mahaicony Districts, Mahaicony Creek and the upper E. C. Demerara.

He paid frequent visits to Pln. Cecilia, E. C., in connection with the reaping of ground-nuts and preparation of land and organisation for the planting of same as a station of the Department.

He supervised Sophia Sugar Experiment Station in the absence of Dr. Whittles from June 1, to November 15, 1927.

Arrangements for judging, in connexion with the West Bank Farmers' Prize Competitions, are in the hands of the Travelling Inspector. It is hoped to have the final judging during the latter end of November.

OBITUARY.

SIR ARTHUR SHIPLEY, G.B.E., F.R.S., M.A., SC.D.,
BORN 1860—DIED 1927.

The death of Sir Arthur Shipley on September 22nd at Cambridge, apart altogether from the loss of so brilliant a scientist to the world in general, must be severely felt in the West Indies. It was he, associated with Lord Milner, and Sir Francis Watts, who was largely responsible for the establishment of the Imperial College of Tropical Agriculture in Trinidad, which Institution is now the poorer by having lost one of its most devoted supporters. The Master of Christ's was a well known figure in the scientific world, and he was not altogether unknown even in British Guiana, which Colony he visited in 1923. He endeared himself to all who were privileged to meet him—his charming personality and brilliant wit were only overshadowed by his wide scientific knowledge.

OBITUARY.

HENRY LEATHEM HUMPHRYS.
BORN 1857—DIED 1927.

It is with very deep regret we have to record the death on Friday, 2nd December 1927, at Georgetown, of Mr. H. L. Humphrys.

Mr. Humphrys was the oldest member of The Board of Agriculture. At the last Meeting of the Board held on 4th October, as senior unofficial member, it was he, who, in well-chosen words, welcomed the new Chairman, Professor Dash.

Mr. Humphrys was a native of the Colony. After leaving the Dollar Academy in Scotland, where he was educated, he returned to the land of his birth in 1875, and joined the profession of planting, starting as an overseer at Pln "Anna Regina," Essequibo. Within five years he was Deputy Manager, and when only four-and-twenty, he was Acting Manager. His ability soon obtained him promotion. In 1888, he was manager of Pln "Greenfield," E.C. Demerara, in 1893, he was appointed manager of Pln. "Chateau Margot," he next assumed the management of Pln "Ogle," eventually in 1904, becoming manager of Pln. "Nonpareil," E.C. Demerara, where he remained in harness until he retired in 1917.

Though he had retired from the actual activities of a planter, nevertheless Mr Humphrys still took a very keen interest in Sugar and its many problems, as well as in minor economic crops and agriculture in general.

He still retained an active part in the affairs of the Colony being the oldest member of The Local Government Board and a Director of Messers, S. Sprostons, Ltd.

He was also a Director of the Georgetown Club. The Royal Agricultural and Commercial Society has also lost one of its keenest members.

Mr. Humphrys was a sportsman in the truest sense of the word, and at one time he was a brilliant cricketer, representing the Colony in Intercolonial matches in the old days. His horses were well-known on the old D'Urban Race Course as well as on the Course at Bel Air. He was also an excellent shot.

As planter, sportsman and christian gentleman, he was an example to all. His largely attended funeral was an index of the respect that was felt for one who will be missed by all classes of the community. To his widow and daughter (Mrs. C. H. E. Legge), his three sons (the Hon. H. C. Humphrys), Mr. H. W. Humphrys (Canada) and C. W. Humphrys (Malay States), we tender our deepest sympathy in their bereavement.

Meteorological Data—July—September 1927.

Recording Stations & Months.	Rain-fall: Total Inches.	Number of Days of Rain: Under ·10 Inch	·10 to ·50 Inch	·50 to 1.00 Inch	1.00 Inch to 2.00 Inches	Above 2.00 Inches	Total days.	Evapo-ration: Inches	Air Temperature and Humidity: Air Temp. Maximum.	Minimum.	Mean	Humidity. Mean
Botanic Gardens.												
July ...	15·21	5	14	..	9	...	28	4·04	85·2	75·1	80·1	81 8
August ...	9·36	4	10	..	2	1	17	4·75	86·4	76·2	81·3	80·0
Sept. ...	3·87	5	3	...	2	...	10	5·39	87·8	75·8	81·8	79·6
Totals	28 44	14	27	...	13	1	55	14 18				
Means.	..	...	...	...	...	...	...	...	86·5	75·7	81·1	80.5
Berbice Gardens.												
July ...	16·70	2	10	1	2	3	21	...	88·4	73·9	81·1	78·4
August	6·39	3	6	1	3	...	13	...	89·3	74·7	82·0	74.2
Sept.	4 37	...	4	...	1	1	6	...	90·5	75·4	82·9	76·0
Totals	27 46	5	20	5	6	4	40	...				
Means		...	.	...	...	...	...	.	8).4	74·7	82·0	76·2
Onder-neeming.												
July ...	4·65	1	3	2	..	1	7	...	89·0	73·0	81·0	...
August ...	12.70	...	5	2	4	2	13	...	89·0	73·0	81·0	...
Sept. ...	2·26	...	1	1	1	...	3	...	89·0	73·0	81·0	...
Totals	19 61	1	9	5	5	3	23	...				...
Means.	...	...	...	.	...	...	...	...	89·0	73·0	81·0	...
Mora-whanna. N.W.D												
July ...	13·45	2	15	6	2	1	26	...	...	...	...	...
August ...	11·13	..	10	9	2	...	21	..	...	...	...	...
Sept. ...	5·32	1	7	2	2	...	12	...	...	...	...	...
Totals ...	29·90	3	32	17	6	1	59	...	...	...	...	...

ATTENDANCES AT THE DISTRICT GARDENS

Year.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequibo.	Den Amstel.	Houston, E Bank.	Wakenaam.	Total Attendances.
1912	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,726
1913 ..	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 .	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,209
1916 ..	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,086
1918 ...	4,834	3,081	1,653	2,671	2,162	2,790	2,067	19,258
1919 ...	4,769	2,425	1,582	2,798	1,851	2,480	1,556	1,4617
1920 ...	6,285	2,312	1,665	2,525	2,532	3,228	2,148	20,695
1921 ..	5,671	1,968	1,642	2,629	1,949	2,539	1,610	18,008
1922 ..	3,557	1,841	1,105	1,593	1,525	1,522	1,397	12,950
1923 ..	4,038	2,780	1,595	1,934	1,953	2,137	1,951	16,388
1924 ..	4,123	2,827	1,103	1,789	1,678	2,146	1,664	15,330
1925	3,317	2,755	1,580	1,819	470	1,663	1,597	13,201
1926 * ...	1,732	2,627	1,219	2,172	364	1,268	1,600	10,982
1927 1st Qr.	414	768	346	683	266	598	598	3,673
2nd Qr.	245	174	252	409	249	327	527	2,183
3rd Qr.	180	420	255	383	150	235	391	2,014

* Decrease in attendances caused by very unfavourable weather conditions.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the first nine months of 1927.

The corresponding figures for the same period during previous years and the average for the same period for nine years previous to that are added for convenience of comparison

Product	*Average 1916-24*	*1925*	*1926*	*1927.*
Balata, cwts. .	1,515	1,872	1,791	5,246
Cattle food (Molascuit) tons	966	861	510	375
Cacao, cwts. ..	75	None	None	None
Cattle, head ..	331	129	11	1
Charcoal, bags ..	35,158	22,653	21,915	28,912
Citrate of Lime, cwts.	190	None	None	None
Coconuts, thousands...	1,735	963	562	187
Coconut Oil, gals. ...	15,196	20,815	15,131	17,268
Copra, cwts. ..	2,901	10,552	32,627	12,633
Coffee, cwts. ..	4,136	5,231	6,700	2,555
Essential Oil of Limes, gals. ..	237	90	228	231
Firewood, Wallaba, etc., tons	5,722	4,607	5,760	7,157
Gums, lbs. ..	2,056	177	1,232	282
Hides, No.	5,016	7,620	7,039	1,781
Kola-nuts, cwts. ...	6	None	None	None
Lime Juice, (conc.) gals. .	5,488	5,474	2,511	1,376
Lumber, ft. ..	146,409	111,256	139,827	170,346
Molasses, gallons	73,535	527,272	954,854	1,639,128
Pigs, No. ...	246	688	411	341
Railway sleepers, No	10,237	30,591	10,743	17,059
Rice, tons ..	6,266	4,880	1,770	7,287
Ricemeal, tons ...	51	None	None	None
Rubber, cwts. ...	65	24	218	278
Rum, gallons ...	1,733,535	900,693	603,729	848,165
Sheep, head ..	32	10	None	1
Shingles, thousands	1,572	1,202	1,049	1,291
Sugar, tons ...	56,456	59,500	57,195	59,398
Timber, cub. ft. ...	84,330	146,975	226,781	141,710